DOCTORAL THESIS

The Effect of Socioeconomic Status on Healthy Life Expectancy of the Elderly in Japan

Suwen Yang

Supervisor: Tanji Hoshi

Tokyo Metropolitan University

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ABSTRACT

The aging of the population is increasing worldwide due to increasing longevity and declining birth rates. Japan leads the world in the pace of aging, with currently over 1 in 5 individuals aged 65 years and over. On the positive side, Japan has ranked first in terms of life expectancy at birth, especially for females. On the negative side, significant aging of the population has increased the number of older people who are bedridden, have dementia, or are in need of long-term care (LTC) or support for daily living. Thus, whether longer life expectancy is accompanied by better health measures within aging populations is becoming a great concern. Shifting the previous narrow focus on length of life, in recent years, healthy life expectancy (HALE) has been increasingly used to measure an individual's health status according to a series of indicators, such as self-rated health (SRH), disability, and disease consequences. The primary purpose of this dissertation is to investigate Japanese HALE and to analyze the consequences of physical disability and comorbidity on HALE at the individual level in the elderly.

Data from Western nations show a well-established inverse gradient between socioeconomic status (SES) and mortality or morbidity. Because the use of SES and health indicators may depend on social context, whether health-related SES variables would diminish, persist, or grow with age is disputed. Although Japan has been long heralded as an egalitarian and largely middle-class society, the trend towards greater socioeconomic equality in terms of health has been less obvious since the 1990s. This trend has coincided with a gradually increasing income inequality. Thus, the second purpose of this dissertation is to examine the SES's impact on HALE in the Japanese elderly, with a special emphasis on direct and indirect effects interacting with gender,

age, and location factors. A series of models estimating the structural causal relationships between individual SES, physical health, and HALE among the Japanese elderly will be validated.

In the LTC field, there is a consensus that disability among the elderly is the primary factor driving the demand for LTC services, leading to the Long-term Care Insurance Law introduced by the Japanese government in April 2000. The third purpose of this dissertation is to explore the structural causal relationships between SES, LTC needs, physical health and HALE in elderly individuals, which would have implications for LTC management in the Japanese elderly. Results from the dissertation may also construct lessons for the evaluation of the nation's health and the impact of health policies for other countries as well.

My doctoral dissertation is organized as follows. Chapter 1 provides an introduction to five key concepts in the development of this dissertation: population aging, HALE, SES, physical health and LTC. Furthermore, I discuss the existing theories about population health status changes and theoretical hypotheses about SES effects on HALE due to the aging of the population. Using findings from the literature, an international comparison, the trend over time, as well as gender and age differences will be presented. Subsequently, I will address the rationale, objectives, methods, and hypothetical model of the dissertation.

Chapter 2 presents an empirical study on "Prefectural mortality in relation to socioeconomic status and long-term care in Japan." Prefectures in Japan were used as units of analysis and 7 indicators were obtained from multiple data sources, which were published by government organizations and public institutions for years centering on 1995, 2000, and 2005. Based on the correlation and linear regression analyses, factors that explain the mortality, LTC and SES variation demonstrated that prefectures with higher socioeconomic level and lower LTC application rates had lower mortality of male and elderly people in Japan. With respect to gender differences, prefectural SES and LTC displayed significant associations with mortality for men but not for women.

Chapter 3 presents a study on "Healthy life expectancy in relation to socioeconomic status and physical health among Japanese elderly." A questionnaire survey was conducted with all residents aged 60 years and older in 16 municipalities of Japan where we could obtain the help of public health centers in 1998. Participants were followed until June, 2000. In all, 15,254 individuals were analyzed. Data analysis was performed by survival analysis and structural equation modeling (SEM) using SPSS 19.0 and AMOS 17.0 for Windows. The data indicated that SES was the determinant of HALE; lower SES of the elderly was associated with an increase in mortality directly and with a decrease in SRH indirectly via physical health status. The significant distribution of SES, physical health and HALE were found by gender, age and location among the elderly people in 16 municipalities of Japan.

Chapter 4 is a study on "Healthy life expectancy in relation to socioeconomic status, physical health and long-term care among Japanese elderly," and aims to elucidate the effects of SES, physical disability, comorbidity, and LTC on HALE among the suburban elderly in Japan. A questionnaire survey was conducted among all residents aged 65 years and older in a suburban area of Tokyo in 2001, with two follow-up studies being conducted in 2004 and 2007. In all, 7,905 respondents were included as analysis subjects. Data analysis was performed using survival analysis and SEM. The results indicated that improvement in SES of the elderly works toward extending their life expectancy of living with good health via improving daily living capabilities and preventing the need for LTC. Significant gender differences were found in the relationship between SES and HALE among the Japanese suburban elderly. Furthermore, with increased age, declining physical health within the high SES category appeared to override the significant effects of SES on HALE for the Japanese suburban elderly.

Chapter 5 summarizes the most important findings and draws conclusions as follows: (1) A SES disparity in terms of HALE was found in Japan, while SES's impact on HALE in the elderly represented a significant direct effect; (2) In addition to the direct effects, indirect effects of SES on HALE in the elderly were transferred by physical health, and LTC levels; (3) There were significant model differences in terms of gender, age, and location of the elderly in Japan. In this section, I also elucidate the new insights that this dissertation has generated, and point out the questions that still remain as well as new questions that have originated. Finally, there are certain issues for future studies in terms of external validity and reliability.

In Japan's aging society, a rapid increase in the elderly population is inevitable. This study promote a deeper understanding and awareness of socioeconomic HALE determinants interacting with gender, age and location, which will contribute to the development of a multi-sectorial health policy to improve the overall health of the elderly people in Japan.

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Chapter 1

Introduction

1.1 Population Aging

1.1.1 Aging in the 21st Century

Population aging — the process by which the median age and the relative proportion of older people are increasing — is widespread across the world. In 1950, there were 205 million people age ≥ 60 years throughout the world (Figure 1.1). Fifty years later, the world's population of people age ≥ 60 years tripled, and is estimated to reach nearly 2 billion by 2050. Between 2000 and 2050, the proportion of the world's population ≥ 60 years old will double from about 11% to 22%; the proportion will increase from 20% to 32% in more developed regions and from 8% to 20% in less developed regions[1] (Figure 1.1).

A society is considered to be an "aging society" when elderly individuals — those age ≥ 65 years — comprise more than 7% of the population; in an "aged society," elderly individuals comprise more than 14% of the total population; and in a "super-aged society," this age group accounts for more than 21% of the total population. Table 1.1 shows that for selected countries, the dates when the population reached, or is expected to reach, each point. Typically, the transition from 7% to 14% elderly individuals took longer in countries that reached the 7% at an earlier date. For example, Sweden and France reached 7% before 1900, and took 85 years and 115 years to reach 14%, respectively. That same transition required only 24 years in Japan, which was an exceptionally short period compared to that for other countries. More developed countries are in general in a more advanced stage of demographic transition, as a consequence of several factors, such as advanced industrial economics and public health systems; thus, the proportions of older individuals in such countries are projected to remain significantly higher than those in less developed regions; indeed, growth of the older population is often more remarkable in more developed counties (Figure 1.1). However, the older population is also growing at a faster rate in less developed regions. As a result, the world will be faced with populations that are aging at a rapid speed.

[1] Less developed regions hereinafter are the names given to countries which, according to the United Nations, exhibit the lowest indicators of socioeconomic development, with the lowest Human Development Index ratings, among all countries in the world.

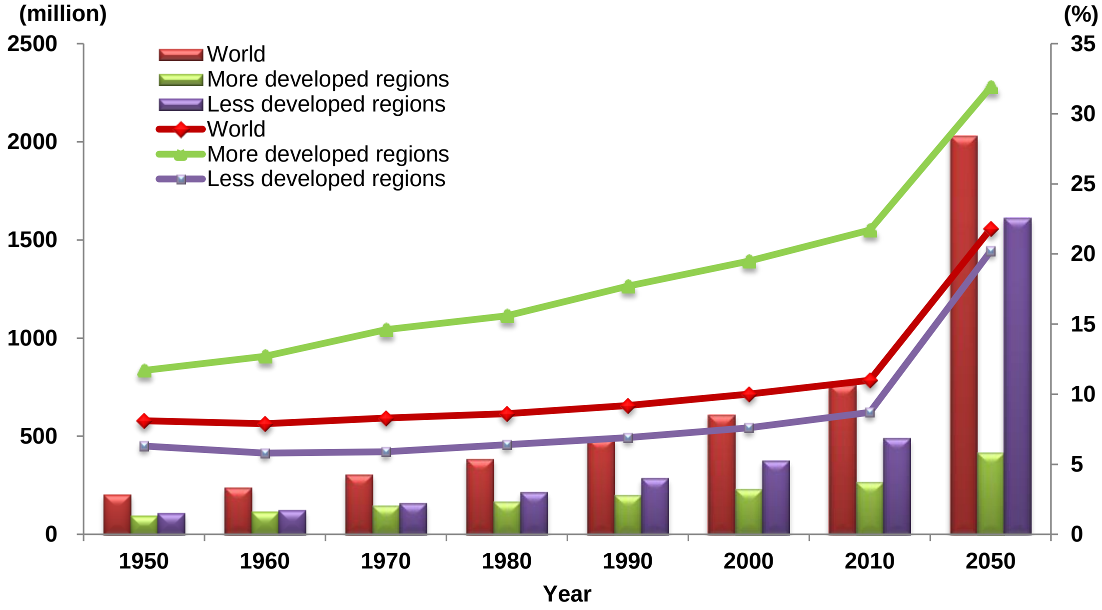

Figure 1.1: Numbers and proportions of population age ≥ 60 years: 1950–2050. (Source: United Nations Department of Economic and Social Affairs, 2011[1].)

Table 1.1: Aging rate in selected countries. (Sources: Ministry of Health, Labor and Welfare, Japan, 2011[2].)

Country	Percentage of population ≥ 65 years old (year attained)			Years required for attainment
	7%	14%	21%	7% → 14%
Japan	1970	1994	2007	24
China	2001	2026	2038	25
Germany	1932	1972	2016	40
UK	1929	1975	2029	46
USA	1942	2015	2050	73
Sweden	1887	1972	2020	85
France	1864	1979	2023	115

Population aging occurs due to two distinct demographic changes: falling fertility rates and increasing longevity. The overall median age for the world rose from 23.9 years in 1950 to 26.7 years in 2000, and is forecasted to reach 37.9 years by 2050. The corresponding figures for more developed regions as a whole are 29.0 years in 1950, 37.4 years in 2000, and 44.3 years in 2050; in contrast, the figures for less developed regions overall are 21.5 years in 1950, 24.1 years in 2000, and 36.8 years in 2050[3]. People are living longer: continuing gains in life expectancy at birth have been experienced globally by both males and females (Figure 1.2). Over the last 6 decades (1950–2010), global life expectancy at birth increased by almost 20 years. However, large variations exist, e.g., between people living in different regions and between genders. The gain in life expectancy at birth for males was 11.2 years in more developed regions and 23.7 years in less developed regions; in females, such gains were 12.9 years in more developed regions and 26.7 years in less developed regions. Sustained gender differences in life expectancy at birth from 1950–2010 have also been observed, ranging from 5.0–6.7 years in more developed regions and 0.8–3.8 years in less developed regions. In addition, as can be seen from data from select countries in the Organization for Economic Co-operation and Development (OECD) presented in Figure 1.3, the life expectancy at age 65 years has been rising for both men and women, although to a somewhat larger degree in women, since 1960. On average, life expectancy at age 65 years increased by 4.4 years for males and by 5.6 years for females in OECD countries from 1960–2009. However, some countries recorded much greater increases. For example, the average life expectancy at age 65 years in Japan rose by 7.3 years for males and 9.9 years for females. This means that people are spending more years as elderly individuals. Moreover, many of the very old lose their ability to live independently due to limited mobility, frailty, or mental health problems. Thus, along with other health challenges for the 21st century, it is important to prepare health providers and societies to meet specific needs of older populations with respect to both quality of life (QOL) and long-term care (LTC) prevention.

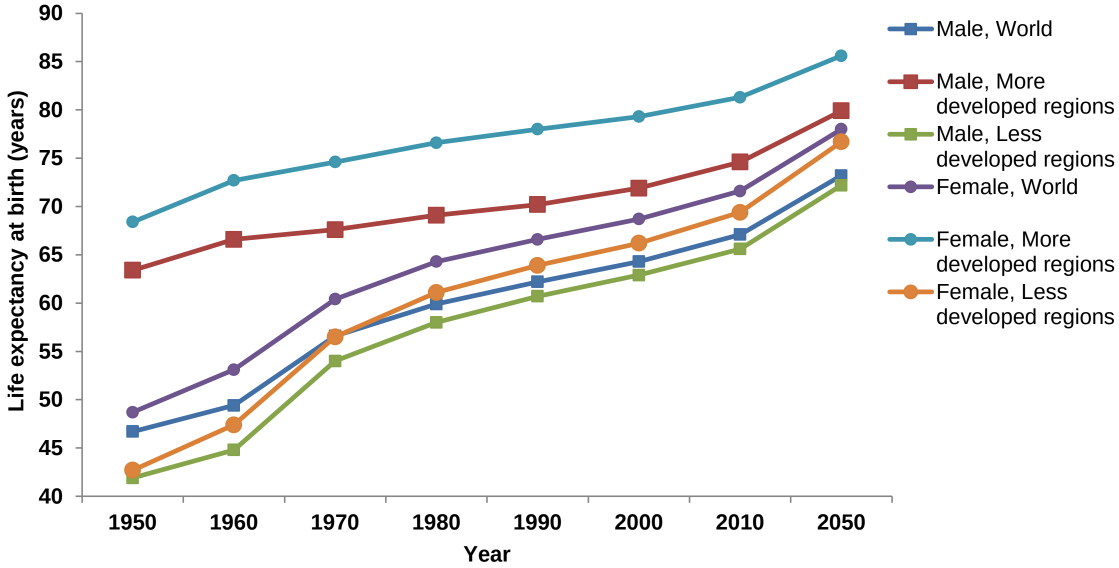

Figure 1.2: Male and female life expectancy at birth: 1950-2050. (Source: United Nations Department of Economic and Social Affairs, 2011[1].)

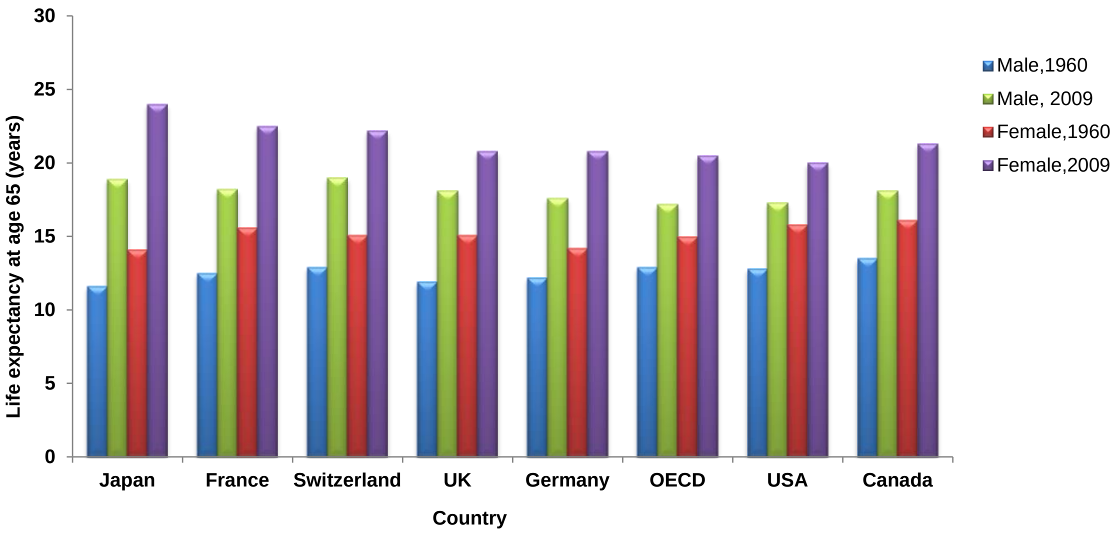

Figure 1.3: Male and female life expectancy at age 65 years in selected OECD countries: 1960 and 2009. (Source: OECD Health Data 2011; World Bank and national sources for non-OECD countries[4].)

1.1.2 Population Aging in Japan

In 2011, the total Japanese population was 127.80 million; about 29.75 million were age ≥ 65 years (12.68 million men and 17.07 million women). The elderly (age ≥ 65 years) represented 23.3% of the total population, in which individuals age 65–74 years (young-old) and ≥ 75 years (old-old) represented 11.8% and 11.5%, respectively, of the population (Figure 1.4). Thus, more than 1 in every 5 people in Japan was ≥ 65 years old, and more than 1 in 10 was ≥ 75 years old. Women are overrepresented due to their longer average life expectancy; for example, there were 16 women for every 10 men among people ≥ 75 years old. The proportion of people age ≥ 75 years was 2.1% in 1970 when Japan became an aging society, a figure that had almost doubled by 1990 to 4.8%, and nearly quintupled by 2010 to 10.9%; it is expected to increase to 24.5% by 2050.

With limited international migration, the rapid aging of the Japanese population is attributed to the steady prolongation of its life expectancy and the sharp drop in its birthrate. Japan has one of the highest life expectancies in the world, and this figure continues to increase (Figure 1.5). The average life expectancy at birth was 79.64 for males and 86.39 for females in 2010, and these figures are expected to increase to 81.39 years for males and 88.19 for females by 2025, after which female life expectancy is projected to exceed 90 years. Furthermore, the average life expectancy at age 65 years was 18.9 years for males and 24.0 years for females in 2009. Compared to 11.6 years for males and 14.1 years for females in 1960, the life expectancy at age 65 years has substantially increased, particularly for women (Figure 1.3). As the total population size decreases, aging will continue to accelerate. By 2055, the Japanese population is projected to drop to 90 million, with 36 million (41%) people age ≥ 65 years.

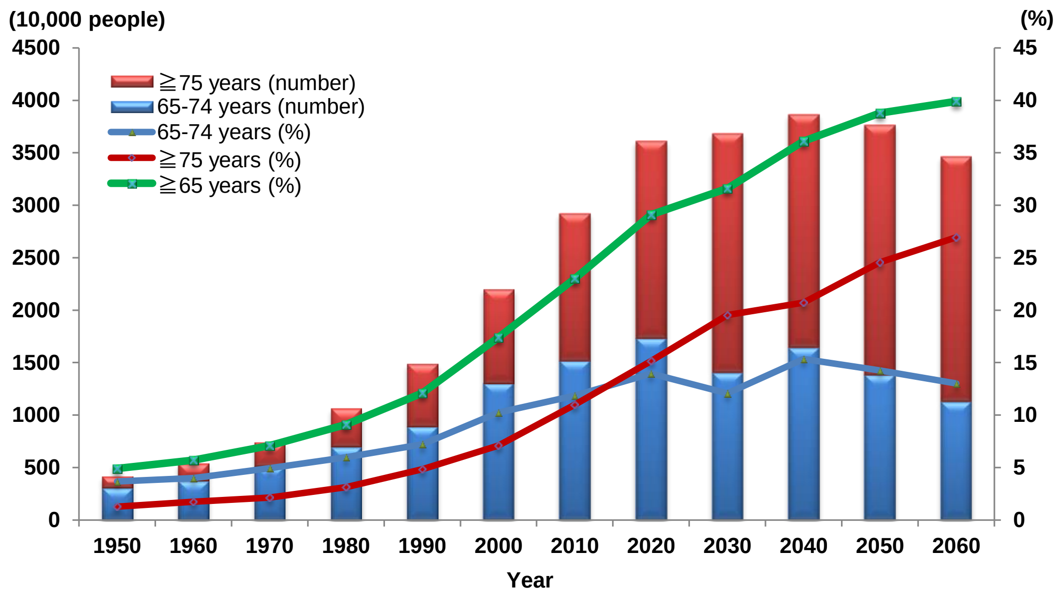

Figure 1.4: Population aging trends in Japan: 1950–2060. (Source: Up to 2010, Ministry of Internal Affairs and Communications, "Population Census." After 2015, National Institute of Population and Social Research, "Projected Population of Japan" in 2011, based on the estimated figure on the assumption that birth and death rates are ranked medium[5].)

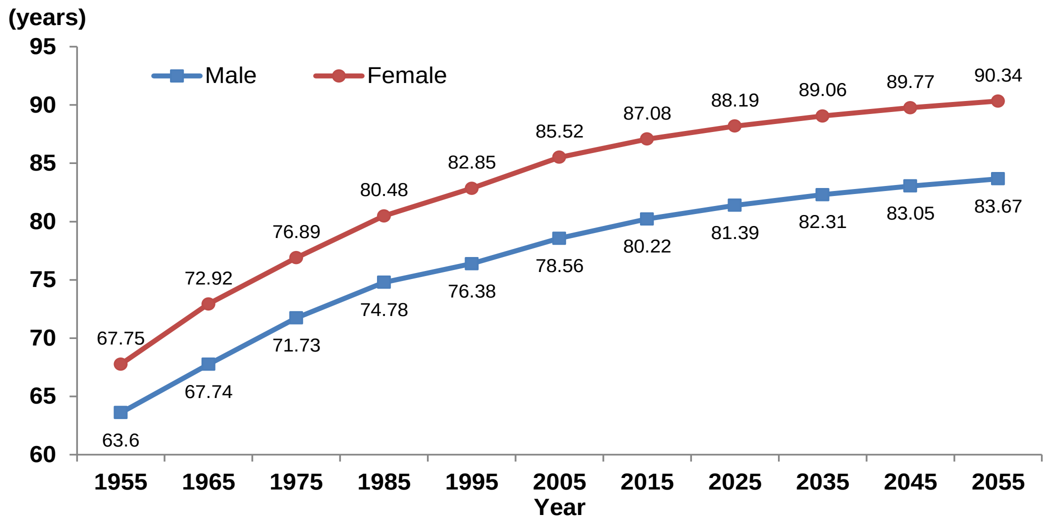

Figure 1.5: Trends in average life expectancy at birth: 1955–2055. (Source: Up to 2005, Ministry of Internal Affairs and Communications, "Complete life tables." "Abridged life table" in 2009. After 2015, National Institute of Population and Social Research, "Projected Population of Japan" in 2005, based on the estimated figure on the assumption that birth and death rates are ranked medium[5].)

Geographic variation of the aging rate in Japan exists. Among the 47 prefectures in 2011, Akita had the highest rate of 29.7% while Okinawa had the lowest rate of 17.3%. Prefectures in major urban areas have relatively low aging rates (shown in red in left map, Figure 1.6), while 35 prefectures show rates higher than the national average of 23.3%. The aging rate in all 47 prefectures is expected to increase in the future. In 2035, the highest percentage of elderly individuals will reach 41.0% in Akita Prefecture; the lowest figure will reach 27.7% in Okinawa Prefecture (right map, Figure 1.6). Simultaneously, increases in aging rates will differ between prefectures; for example, the aging rate will increase remarkably from 2011 to 2035 in Saitama Prefecture (12.9%) and Chiba (12.2%). Thus, services for the rapidly increasing elderly populations in some regions will be necessary.

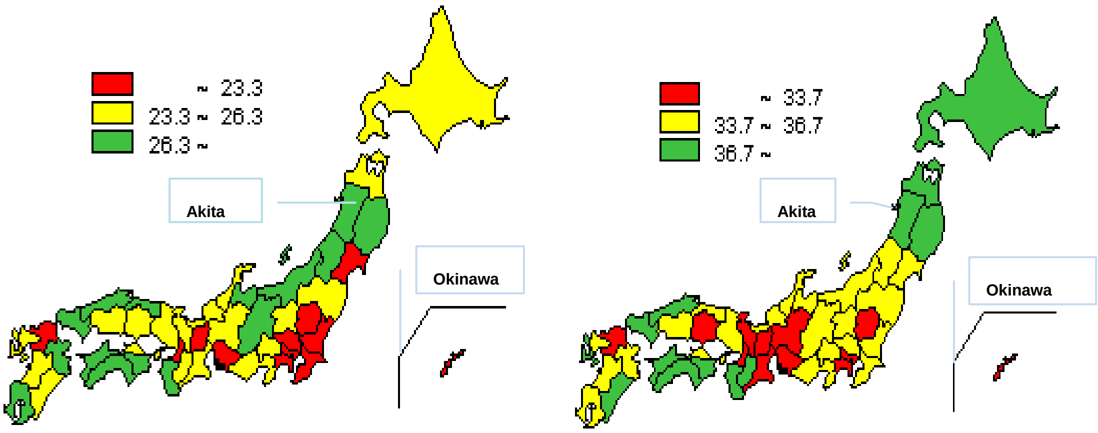

Figure 1.6: Aging rate trends in the 47 prefectures: 2011 (left) and 2035 (right). (Source: Ministry of Internal Affairs and Communications, Projected Population of Japan, 2011.National Institute of Population and Social Research, "Projected Population of Japanese 47 prefectures" in 2006[5].)

1.1.3 Theories about the Population Health Status Changes Due to Aging

In 1984, a general model of health transitions was proposed that distinguished between mortality, morbidity, and disability to explain the different states of life: total survival, survival without chronic disease, and disability-free survival. The model is portrayed using three main curves: 'mortality,' 'disability,' and 'morbidity'[6]. Three main theoretical hypotheses that highlight the effects that an observed decline in mortality might have on the morbidity and disability of the elderly in the future are described below.

Compression of Morbidity

Fries initially proposed that life expectancy was approaching a maximum limit in the 1980s[7]. This optimistic compression scenario suggests that the burden of illness may be reduced by postponing the onset of chronic diseases/disability, due to medical progress and improved general health improvements, such as prevention of being overweight or obese, quitting smoking, and physical practices. Thus, the proportion and quantum lifetime spent in good health toward the end of life has increased. The health transition model can illustrate the hypothesis that if the 'mortality' curve remains stable, both the 'disability' and 'morbidity' curves shift upward and the areas between 'mortality' with 'disability' and 'morbidity' are reduced. However, in combination with the increased number of older people in this scenario in the future, long-term care costs would be mitigated if extra years of life are spent in good health. Thus, the policy implication of this rather optimistic theory is that health resources should be shifted to the later stages of life and for a shorter period of time[8].

Expansion of Morbidity

The expansion of morbidity theory poses the pessimistic view that gains in life expectancy predominantly occur through the technological advances that have been made in extending the life of those with disease and disability[9]. In detail, medical advances extended the lifespan of a much broader spectrum of the population, thus increasing the survival of the frail elderly and leading to more years lived with non-fatal disabling diseases of old age, such as Parkinson's disease, dementia, and arthritis[10,11].

Gruenberg[12] originally characterized this rather expressively as the “failure of success”. The health transition model can illustrate the hypothesis that if both the ‘disability’ and ‘morbidity’ curves remain stable, the ‘mortality’ curve shifts to the right and the areas between ‘mortality’ with ‘disability’ and ‘morbidity’ are expanded. Thus, as the older population grows, the demand for health and social care services as well as the pressure on careers and communities will rise dramatically due to the increase in morbidity.

Dynamic Equilibrium

Manton[13] proposed a dynamic equilibrium in which progress is made in prolonging both total and healthy lifespans, leading to approximate stability in the ratio of healthy lifespan to total lifespan. In other words, although more disability is possible, it would be light and moderate, with a dynamic equilibrium maintained. The health transition model illustrates this hypothesis by expanding the area between ‘morbidity’ and ‘mortality;’ if the disability is considered to be a severe morbidity, the area between ‘disability’ and ‘mortality’ remains the same. This scenario does not envisage greater long-term social care costs, but primary care and long-term health services could experience greater pressure[14].

1.1.4 Global Studies on the Population Health Status Changes Due to Aging

The above-mentioned hypotheses constitute the background for several studies, which attempted to understand whether the mortality reduction is accompanied by improvement or deterioration of the population’s health status[15]. However, these studies did not yield consistent results.

Since 1991, many published studies have contributed considerably to the body of evidence indicating an absolute expansion of morbidity/disability, such as in Australia[16], the United Kingdom (UK) [17], Japan[18], and Taiwan[19]. The first wave of very robust evidence for this altered view of disability trends in the older population came from the United States[20, 21]. In the National Long Term Care Study (NLTCS) conducted in the late 1980s and the 1990s, the age-specific disability rates were lower in the 1990s than in the 1980s, indicating a significant reduction in the rate of functional decline in old age during those two decades. In addition, a few other countries, such as Austria[22] and

Denmark[23], appeared to have experienced an actual contraction of the period of disability at the end of life. Strong evidence from New Zealand[24] and the Netherlands[25, 26] indicated an expansion of disability attributed primarily to an increase in age-specific prevalence rates for mild-to-moderate disability rather than severe disability, thereby lending support to the dynamic equilibrium hypothesis. A recent OECD study yielded mixed results regarding activities of daily living (ADL) disability trends, which denote a severe level of disability among individuals age ≥ 65 years. Of the 12 countries studied, only 5 (Denmark, Finland, Italy, the Netherlands, and the United States) showed clear evidence of a decline in disability among elderly people. Three countries (Belgium, Japan, and Sweden) reported an increasing rate of severe disability among people age ≥ 65 years, and two countries (Australia and Canada) reported stable rates. In France and the UK, data from different surveys showed different trends in ADL disability rates, making it impossible to reach any definitive conclusions regarding the direction of the trend[7, 27].

Most countries are experiencing a strong increase in life expectancy due to medical, cultural, and social causes. It is unknown whether an upper limit of human life expectancy exists and what this limit could be. The resulting patterns in different countries can be concluded as follows: 1) living longer exposes more people to non-fatal disabling diseases of old age; 2) improved control of the progression of chronic diseases leads to a dynamic equilibrium between the decrease of mortality and the increase in disability; 3) improved medical care and health behaviors compressed the amount of time people live with disease and disability into a short period before death; and 4) the eventual emergence of very old and frail populations leads to a new expansion of morbidity[28]. Even though these four theories are generally understood as mutually exclusive alternatives, the causal factors they each highlight are not. The theories are mutually exclusive insofar as they state that the primary causal driver behind the continuing postponement of death by chronic disease is either delayed onset (as a result of improved primary prevention), delayed progression of disease (as a result of improved secondary prevention), or increased survival with severe disease (as a result of improved tertiary prevention) [28].

1.2 Healthy Life Expectancy (HALE)

1.2.1 Definition of HALE

The increasing number of older people, higher expectations of 'good health' within society, and policy interest in the potential for reducing public expenditures have led to international interest in the enhancement and measurement of the QOL of elderly people. In 1998, the Institute of Medicine's Committee on Summary Measures of Population Health[29] concluded that "mortality measures, although important, provide decision makers incomplete and insensitive information about overall population health. Summary measures of population health need to recognize the physical and psychological illnesses and disabilities that cause much individual suffering and limit social and economic advances within and across nations." Accordingly, the 'healthy life expectancy (HALE)' measure, which is also called 'health-adjusted life expectancy,' is used to summarize this notion.

Sanders[30] first elaborated the concept of HALE in 1964, but it was not until the early 1970s that Sullivan[31] proposed a simple method for estimating life expectancy as a function of disability. HALE as proposed by the WHO in 2000 refers to 'the length of life lived in full health,' which summarizes mortality and non-fatal outcomes in a single measure of average population health[32]. HALE as a natural extension of life expectancy combines quantity and quality of life into a single measure, and divides the remaining number of years into good or bad health. Thus, HALE addressed whether or not longer life is accompanied by the compression or expansion of morbidity.

1.2.2 Measures of HALE

HALE is derived from Sullivan's method, which accounts for both mortality and morbidity in a single index within a representative sample in time[31]. The values are based on age-specific death rates for a particular calendar period together with comparable health state prevalence by age. Total lifetime can be divided into healthy periods and periods of health impairment[33].

The WHO[34] defined health as a state of complete physical, mental, and social well-being, not merely the absence of disease or infirmity. As many dimensions of health exist, many HALEs also exist. Thus, HALE can be measured in several ways, including life expectancy in good self-rated health (SRH), free of disability, free of a specific disease, or free of LTC. Such single measures of overall population health provide a useful adjunct to measures of health gaps, such as disability, morbidity, and SRH, which are often disaggregated by disease and injury[35]. The previous studies on HALE indicators that are related to my doctoral dissertation were researched and are described below.

Disability

Early work on HALE focused on disability-free life expectancy (DFLE). Combining disability and mortality, if the calculated HALE increases at a slower rate than life expectancy, a pandemic of disabilities might be expected; if HALE increases at a similar rate, there would be no change; and if the increase is larger, compression of disability would be confirmed. Measures of disability are important because they provide appraisal of the burden caused by suboptimal health by considering other factors (e.g. underlying disease, and psychological and social factors).

To understand and evaluate disability, it is important to have an understanding of the progression of disability, ending with a loss of functioning. In 1980, the "International Classification of Impairments, Disabilities, and Handicaps (ICIDH)" was published by the WHO. Disability was defined as follows: "in the context of health experience, a disability is any restriction or lack (resulting from impairment) of ability to perform an activity in the manner or within the range considered normal for a human being"[36]. Then, this model has been revised into the "International Classification of Functioning, Activities and Participation (ICF)" [37], which focuses on 'components of health as human functioning' instead of 'disabilities as consequences of disease' in a universal system. The ICF places the notions of 'health' and 'disability' in a new light — it acknowledges that every human being can experience a decrement in health and thereby experience some degree of disability. Disability is not something that only happens to a minority of humanity. Furthermore, personal and environmental factors as contextual factors are an essential component of the classification and interact with all three dimensions of health; thus, changes in the social and ecological environments can alter health conditions (Figure 1.7).

Most current studies of disability among the elderly focus on the ability to carry out ADL, which include daily activities in the home, at work, and at leisure. Most measures include two phenomena: Basic Activity of Daily Living (BADL) developed by Katz and colleagues in 1963[38], and Instrumental Activities of Daily Living (IADL) developed by Lawton and Brody in 1969[39]. BADL includes basic daily tasks that need to be performed by all people regardless of gender, culture, housing conditions, housing environment, and leisure time interest[40], such as bathing, dressing, using the toilet, and eating. IADL includes more complex, outgoing activities that are essential for living an independent life in society[41]. In addition to these two measures, disability can also be accessed through mobility performance, objective measures that evaluate standardized tasks, such as standing in balance, walking distance, climbing stairs, and chair stand tests, among others by means of counting repetitions or timing the task. ADL is associated with dependence, so ADL levels have been found to be significant predictors of all-cause mortality, the levels of care at which people should receive institutionalization, and increase, use of hospital services[42-44].

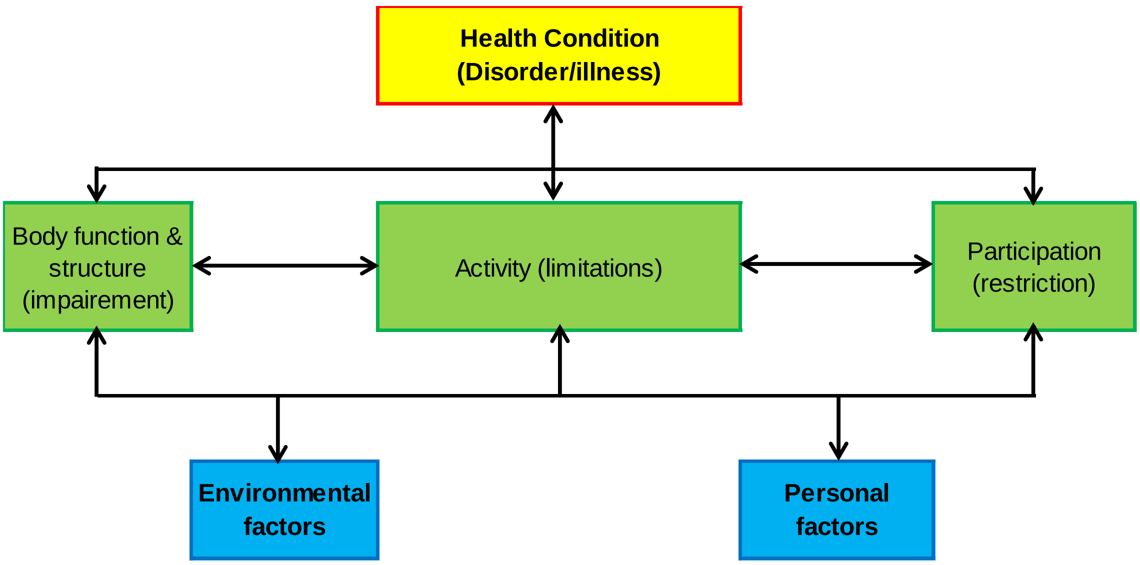

Figure 1.7: ICF model. (Source: WHO, 2001[37].)

Diseases

The term 'disease' broadly refers to any condition that impairs normal function, and is therefore associated with dysfunction of normal homeostasis. HALE is an estimate of the number of healthy years free from the burden of disease, which is the impact of a health problem in an area measured by financial cost, mortality, morbidity, or other pertinent indicators. Several measures are used to quantify the burden imposed by disease on people. The first measure is years of potential life lost (YPLL), which estimates the number of years that a person's life was shortened due to disease. However, the measure does not account for how disabled a person is before dying, and treats a person who dies suddenly and a person who died at the same age after decades of illness as equivalent. Another measure is the disability-adjusted life year (DALY), which considers the part of the years lost to being sick. Unlike YPLL, DALY reflects the burden imposed on people who are very sick but who live a normal lifespan. According to the Global Burden of Diseases Study 2010 (GBD)[45] report, infectious diseases, maternal and childhood illness, and malnutrition now cause fewer deaths and less illness than they did 20 years ago. As a result, fewer children are dying every year, but more young and middle-aged adults are dying and suffering from disease and injury, as non-communicable diseases, such as cancer and heart disease, become the dominant causes of death and disability worldwide[45].

It had thus been well documented that a number of chronic diseases are observed more frequently in disabled elderly adults than in those who are not disabled. However, not all diseases cause disability, and some diseases cause more disability than others. Diseases with large effects on functional ability include stroke and other neurological disease, heart disease, respiratory disease, high body mass index, diabetes, depression, dementia, and musculoskeletal disease[41]. Although different medical conditions impose functional problems that are specific to each disease, musculoskeletal disease is a chronic disease that affects two dimensions of functional limitations and disability: mobility and ADL. The presence of more than one chronic disease in an individual — or comorbidity — has been reported to be related to the presence of disability and to that person's future risk of disability. For example, the number of chronic diseases in a disability-free group at baseline is directly associated with the risk of losing mobility over four years[46]. Furthermore, after four years, the risk of becoming disabled is 4-fold higher for a person with chronic diseases than for a person with no chronic diseases[47]. In some instances, a disease may increase the risk of subsequent functional disability in itself, but it may also increase the risk of subsequent functional decline when a new condition develops[48]. Schroll et al.[49] observed a step-wise increase in disability with an increasing number of chronic conditions.

Long-term Care/Support

The rapid aging of society is leading to a rapid increase in the numbers of disabled individuals who need LTC or support. In most countries, care predominantly remains a family task that is primarily performed by women. However, the increasing proportion of women in the labor market and the declining ratio between those needing care and those who are potential caregivers are raising questions about the family's ability to care for the elderly who need LTC or support for their daily activities[50]. While all developed countries provide LTC services, only a few of them have implemented LTC systems based on legislation and entitlement principles, such as Germany and Japan.

A recent study calculated HALE using the disability prevalence based on LTC insurance data in select developed countries[33]. Average life expectancy can be qualitatively divided into lifetime spent in good health and lifetime spent in LTC (average care duration). The results not only described the evaluation of HALE, but also the effects of disease prevention programs or health promotion programs.

As an example, in Japan, LTC insurance was introduced for elderly individuals requiring nursing care, and certified people are classified into one of six care levels according to the severity of their disability and care needs. As municipal governments manage LTC insurance, data are routinely available at the municipal as well as the prefectural level, and are used as a source of disability prevalence data[51]. Seko et al.[52] calculated the expected years of life with care needs by age group and prefecture in Japan from 2005–2009, showing that the expected years of life with care needs at age 65 years increased from 1.43 years in 2005 to 1.62 years in 2009 for men, and from 2.99 to 3.44 years for women. As a proportion of total life expectancy, these values showed an increase from 7.9% to 8.6% in men and from 12.9% to 14.4% in women. In addition, the expected years with care needs did not increase in people age 65–69 years and

70–74 years, but markedly increased among individuals ≥ 85 years old. These results indicated that the duration of senior life with disabilities increased in the Japanese population, particularly for the oldest-old people.

Self-rated Health

HALE is commonly used in attempts to assess how many years people lived in good health over the lifespan based on the global SRH scale. SRH as a subjective measure refers to the way that individuals feel about their own health, rating it from ‘very poor’ to ‘very good.’ This assessment tool was introduced in the United States in the late 1950s, and has become a convenient means through which health information can be collected. However, this particular health measure has both strengths and weaknesses[53].

In terms of strength, SRH is a good fundamental indicator of overall health status, and is almost always measured in large population health surveys. SRH can reflect aspects of health incorporating physical, mental, and social health, and can even predict mortality. Furthermore, an extensive body of literature reflecting a variety of settings and cultures has consistently demonstrated that SRH is a strong and independent predictor of subsequent illness, as well as both all-cause and specific mortality[54-56]. For example, respondents reported their health to be poor or very poor on average had increased risk of mortality than those reported having good health. This association was independent of age, blood pressure, and a range of chronic diseases[57]. Hence, SRH can provide valuable insights into the potential demand for health services and LTC needs of the elderly in an aging society.

A major weakness of SRH is its subjective nature. SRH is assessed broadly and subjectively by the respondents themselves, rather than by physician diagnoses or other more objective indicators of health, such as chronic conditions, functional limitations, and disability. Consequently, SRH reports could be prone to the effects of exogenous factors, such as gender, race, and income level, as well as changes in attitudes and expectations toward health over time[53, 58]. In brief, SRH allows for at least some measure of comparison across very diverse settings, because the results can be divided into categories representing poor health and good health. Thus, SRH provides a good starting point for comparisons of HALE across settings.

Using SRH, studies conducted in some developed countries showed inconsistent HALE results: upward trends for both men and women were observed in Finland[59] from 1978–1986, Great Britain[60] from 1980–1996, and Austria[61] from 1978–1998; a downward trend was observed in Germany[62] from 1986–1995, while in the Netherlands[63], from 1983–2000, an upward trend was observed for men, while a downward or stable trend occurred for women. In Japan, Young et al.[53] examined the increasing life expectancy of Japanese men and women in relation to their SRH from 1986–2004. The results showed that the gains in life expectancy in both genders and at all ages primarily occurred in years of good SRH prior to 1995, while the gains in years of poor SRH occurred from 1995–2004. The exception was for women at age 85 years, among whom an almost continuous increase in the number of years living in poor health was observed. The proportion of life spent in different health states suggested evidence of morbidity compression until 1995, followed by an expansion of morbidity.

1.2.3 Review of HALE in the World

HALE has been extensively used to compare health between countries and to reflect many social, economic, and environmental influences, as well as other demographic variables. The Global Burden Diseases Study 2010 was the largest systematic effort conducted to measure the global distribution and causes of a wide array of major diseases, injuries, and health risk factors. The HALE for 187 countries from 1990–2010 and the comprehensive comparisons defined by gender, age, and socioeconomic groups are described below[32].

Gender

In 2010, HALE at birth was 59.0 years (range, 57.3–60.6 years) for men and approximately 63.2 years (range, 61.4–65.0 years) for women (Table 1.2). Although male life expectancy at birth increased from 1990–2010 by 4.7 years and female life expectancy at birth increased by 5.1 years, the HALE at birth increased by only 4.2 years and 4.5 years, respectively, suggesting that the world's population loses more years of healthy life to disability today than it did 20 years ago. Although HALE, like life expectancy, remains higher in women, women continue to lose more years to disability than men, and overall the gap between genders in both life expectancy and HALE continues to widen.

Age

In 2010, global HALE at age 60 years was approximately 14.4 years (range, 13.6–15.2 years) for men and 17.0 years (range, 16.1–17.9 years) for women, and had increased 1.4 years for men and 1.7 years for women since 1990 (Table 1.2). However, as mentioned before, HALE at birth had increased 4.2 years for men and 4.5 years for women since 1990, suggesting that the importance of the gap between the genders in HALE diminishes with age.

Table 1.2: Global HALE by gender and age in 1990 and 2010. (Source: Global Burden of Disease Study, 2010[32].)

	Male healthy life expectancy				Female healthy life expectancy			
	1990		2010		1990		2010	
0 years	54.8	(53.2–56.3)	59.0	(57.3–60.6)	58.7	(56.9–60.3)	63.2	(61.4–65.0)
1 years	58.1	(56.3–59.5)	60.7	(58.9–62.3)	61.4	(59.6–63.1)	64.6	(62.7–66.3)
5 years	55.5	(53.8–57.0)	57.7	(55.9–59.3)	58.8	(57.0–60.5)	61.6	(59.7–63.3)
10 years	51.1	(49.5–52.6)	53.2	(51.5–54.8)	54.4	(52.6–56.1)	57.0	(55.2–58.7)
15 years	46.7	(45.2–48.1)	48.7	(47.1–50.2)	50.0	(48.3–51.6)	52.5	(50.8–54.2)
20 years	42.5	(41.0–43.8)	44.4	(42.8–45.8)	45.8	(44.1–47.3)	48.2	(46.6–49.8)
25 years	38.4	(36.9–39.6)	40.2	(38.8–41.6)	41.6	(40.1–43.1)	44.1	(42.5–45.6)
30 years	34.3	(33.0–35.5)	36.2	(34.8–37.6)	37.6	(36.1–38.9)	40.0	(38.5–41.4)
35 years	30.3	(29.1–31.5)	32.3	(30.9–33.5)	33.6	(32.2–34.8)	35.9	(34.5–37.3)
40 years	26.5	(25.3–27.5)	28.4	(27.1–29.6)	29.6	(28.4–30.8)	32.0	(30.6–33.2)
45 years	22.7	(21.6–23.7)	24.6	(23.4–25.7)	25.8	(24.6–26.9)	28.0	(26.8–29.2)
50 years	19.2	(18.2–20.1)	21.0	(19.9–22.0)	22.1	(21.0–23.1)	24.2	(23.1–25.2)
55 years	15.9	(15.1–16.7)	17.6	(16.6–18.5)	18.6	(17.6–19.5)	20.5	(19.5–21.5)
60 years	13.0	(12.2–13.7)	14.4	(13.6–15.2)	15.3	(14.5–16.1)	17.0	(16.1–17.9)
65 years	10.3	(9.7–10.9)	11.6	(10.8–12.3)	12.3	(11.6–13.0)	13.8	(13.0–14.5)
70 years	8.0	(7.4–8.5)	9.0	(8.4–9.6)	9.6	(9.0–10.2)	10.9	(10.2–11.5)
75 years	6.0	(5.6–6.5)	6.9	(6.4–7.4)	7.3	(6.8–7.8)	8.3	(7.8–8.9)
80 years	4.4	(4.1–4.8)	5.1	(4.7–5.5)	5.3	(4.9–5.7)	6.1	(5.7–6.5)

Data are point estimates (95% uncertainty intervals; years).

Socioeconomic Group

Across countries, male HALE at birth in 2010 ranged from 27.8 years (range, 17.2–36.5 years) in Haiti to 70.6 years (range, 68.6–72.2 years) in Japan; female HALE at birth in 2010 ranged from 37.1 years (range, 26.8–43.8 years) in Haiti to 75.5 years (range, 73.3–77.3years) in Japan. Male HALE at birth in 2010 was below 50 years for 29 countries, compared to only 18 countries for female HALE. In 2010, 38 countries had a male HALE at birth of ≥ 65 years, compared to 86 countries for female HALE.

The gap increases appreciably between genders when socioeconomic groups are considered, an observation that further highlights health inequities, particularly for women, in whom no disparities are observed when life expectancy is considered alone[64]. People in more developed countries not only live longer, but they also spend a significantly smaller proportion of their life with disability and morbidity. Calculation of HALE suggests that health disparities are greater between social groups than between genders.

1.2.4 The Significance of Studying HALE in the Elderly

Globally, the increase in numbers and proportions of old and very old people has increased the concerns and worries of both the aging individuals themselves and health care planners. Individuals worry about declining intellectual abilities and physical health, while the changing demographic patterns are also coupled with worries that society may have to struggle with the aging process to deal with difficult issues such as the financial burden of providing for old age, and increasing demands on social and medical care in case of disability. These combined points of views of the individual and the society constitute the primary reason why an important goal of gerontological research, geriatric medicine, and public health is to increase HALE, which refers to the length of life lived in full health, considering disability, disease, LTC, and SRH.

Japan leads the world in the rapid pace of aging and highest HALE; thus, evaluation of HALE in Japan may provide evidence of trends of morbidity compression or expansion across all ages for both genders by calculating the proportion of life lived in different health status. Additionally, evaluation of HALE will be important for projecting the needs of health care in an aging population and evaluating the effects of interventions and policy changes on both the length and quality of life.

1.3 Socioeconomic Status Effects on HALE of the Elderly

Previous epidemiological, demographic, and sociological researches provide persistent and almost universal findings on social differences in health and mortality. Generally, lower SES has been shown to be related to increased risk of mortality and morbidity. From a lifespan developmental perspective, it is important to explore whether the strength of this relationship varies with age. Studies examining social inequalities in health rarely considered the elderly, but evidence is currently mounting that SES plays an important role in health in later life[65]. However, the diversity of pathways, settings, and mechanisms from SES to HALE remains overwhelming.

1.3.1 Measures of Socioeconomic Status

SES can be broadly conceptualized as one's social capital and position in a society characterized by social inequality. Sociologists emphasize a Weberian approach that encompasses the notion of class, status, and power. However, the existing research results suggest that SES is a multifaceted construct, including at least income, education, occupation, and wealth, which is related to health in diverse ways. Each life stage seems to require different indicators to measure the SES effect on health. As people age, their life has changed, including their status in society and their own social relationships. Accordingly, the indicators that can reflect people's SES also change, particularly for older people. In general, education, income, and occupation, or a composite of these three dimensions, were adequately examined in previous studies, as described below.

Education

Kitagawa and Hauser[66] used educational attainment as their primary indicator of SES, and since then, education has played a central role in analyses of the SES effect on health, because it is easily recorded and remains stable over an individual's lifetime[67]. A person's relative status within society, which can be considered as social class according to Weber's notion, may be related to the high educational attainment of high school or college degrees. Higher education implies more knowledge about health and health behavior, and shapes the ability to inform certain lifestyle choices to promote health in later life.

Income

If education represents human and social capital at the beginning of adulthood, annual income represents only recent accumulation of material resources or the financial situation, which is thought to be closely associated with the class or economic component of Weber’s notion of social class. Relative social class is closely related to potential access to different lifestyles, a sense of security, and the opportunity to fulfill material desires. In addition to providing means for purchasing health care, higher incomes can provide better nutrition, housing, schooling, and recreation[68].

Occupation

Compared with income and educational level, occupational status is a more complex variable, and its measurement varies depending on one’s theoretical perspective about the significance of various aspects of work life. Occupation can be seen as a proxy for representing Weber’s notion of socioeconomic position, as a reflection of a person’s place in society relative to their social standing, income, and intellect[69]. Considering that most elderly individuals are not or will not for much longer be part of the labor force, occupation-based measures can only have an aftereffect, and it is unclear how strong these effects are relative to new and current living conditions.

1.3.2 Socioeconomic Status of the Old Population

In the World

Studies have established that lower SES is associated with increased levels of illness and mortality. For elderly individuals, advanced age is characterized by a withdrawal from permanent employment and a reduction in working hours. The outcome is typically a huge drop in income. Globally, older people today are significantly less likely to participate in the labor force than they were in the past. As the data from the United Nations[3] have shown, labor force participation of people age ≥ 65 years declined by more than 40% at the global level from 1950–2000. Among men, labor force participation decreased from 55% in 1950 to 30% in 2000, while in women, the reduction was from 14% in 1950 to 10% in 2000. In addition, the female share of the older work force is increasing, particularly in more developed countries. In general, education levels have improved in each generation over the last century, and the widespread attainment of at least primary education has been established in more developed regions. As a result, literacy among the older population is nearly universal in more developed regions; however, illiteracy remains high among older people in less developed regions, particularly among women.

The Gini coefficient is commonly used as an international measure of inequality of income distribution, in which 0 corresponds to perfect equality and 1 to perfect inequality. The Gini coefficient has risen significantly since the mid-1980s in OECD countries. In 2008, the average Gini coefficient was 0.309 for people age 18–65 years and 0.288 for people ≥ 65 years (Figure 1.8). The degree of income inequality for the 18- to 65-year-old group was greater than that for the ≥ 65-year-old group at the average level, indicating that income inequality decreases in old age as a result of retirement and associated pension and other income security benefits. However, some countries showed different characteristics, such as the United States, Japan, and France. Figure 1.9 shows another international inequality indicator, relative poverty rate (%), which is the percentage of people with an income ≤ 50% of the median income in OECD countries. Japan has one of the highest Gini coefficients among OECD countries, with all poverty rates being much higher than the average level of OECD in all age groups.

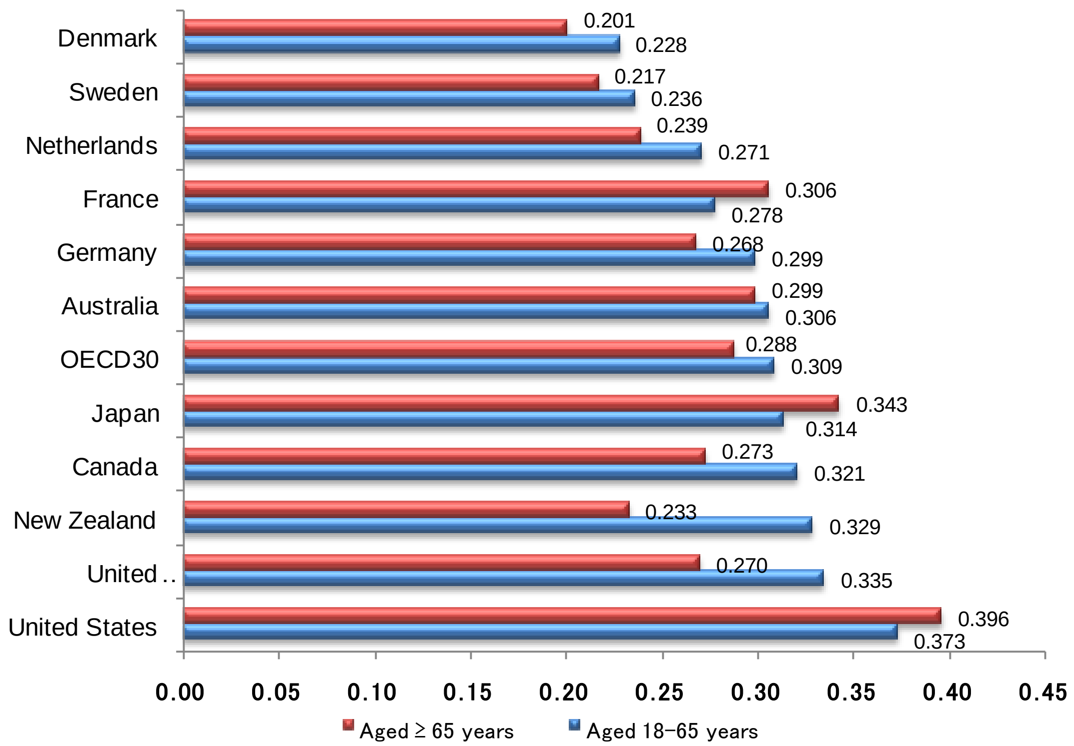

Figure 1.8: Gini coefficient of OECD countries. (Source: OECD, 2008[70].)

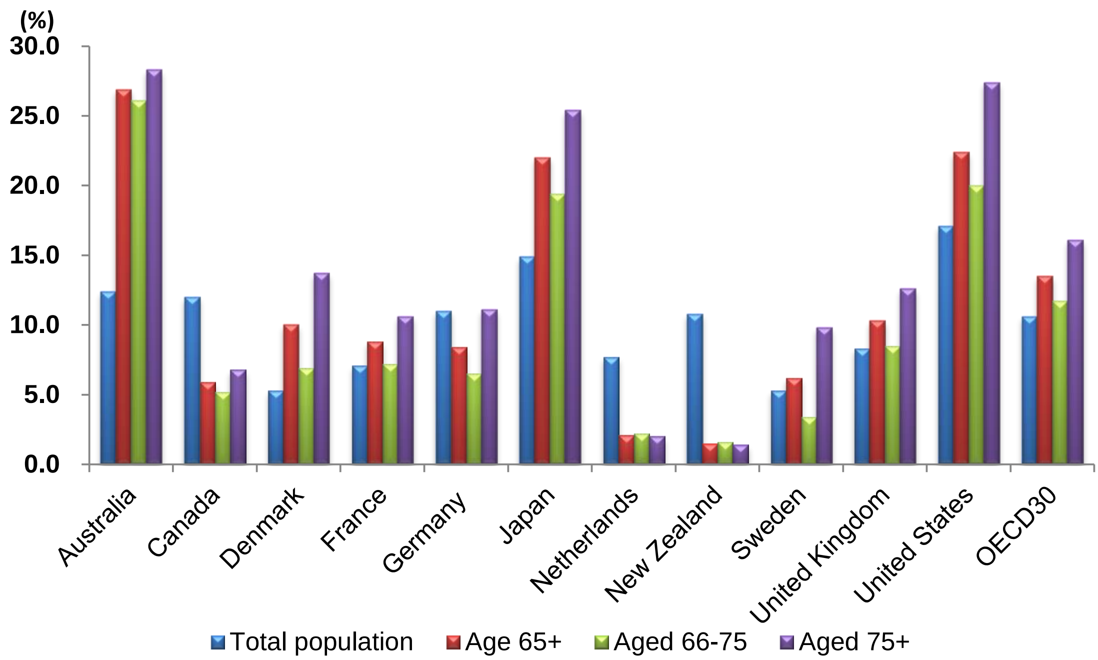

Figure 1.9: Relative poverty rates (%) of OECD countries. (Source: OECD Income Distribution and Poverty Database, 2008[70].)

In Japan

In Japan, accelerated economic growth and technological advancement have enhanced health and life expectancy, particularly after the Second World War. It seems that Japan's health expenditure and health and welfare system organization, along with specific social and cultural particularities, translate into reduced socioeconomic differences in health outcomes. However, increases in social and health inequalities have been recently reported in Japan, which may be partially due to population aging[71].

The average gross household income and the average gross income per household member by the age bracket of the household head are shown in Figure 1.10. In 2006, the total average income per household and average income per household member were 5.67 million yen and 2.07 million yen, respectively. The average household income of all other households is higher than that of households headed by someone ≥ 65 years old (4.32 million yen), except those headed by individuals ≤ 29 years old.

The income distribution of people ≥ 65 years old is different than those in other age groups. Figure 1.11 shows how income is distributed for all households and aged households. Overall, 78.7% of households headed by individuals age ≥ 65 years earned an annual income of < 4 million yen in 2006. The average income of all households is evenly distributed over a range of 1 million to 8 million yen; however, the distribution of aged households becomes increasingly skewed to the lower income brackets. In 2010, the average annual income of households headed by elderly people was 4.29 million yen, which is much lower than the average 5.24 million yen income of all households. Reflecting this reality, the Gini coefficient for households headed by people ≥ 65 years old is approximately 0.34, which is higher than the Gini coefficient of 0.31 for households headed by individuals age 18–65 years (Figure 1.8).

In Japan, the average amount of schooling completed is 12.3 years per person, more than 90% of the population attends high school, and approximately 40% of all upper-secondary school graduates advance to tertiary education. The education level in Japan has tended to increase over time: for example, among OECD countries, Japan is ranked in the tenth position among 55- to 64-year-olds (those who completed their education some 40 years ago) and in the third position among 25- to 34-year-olds (those who completed their education a decade ago) [73]. Due to the extremely high popularity of higher education, particularly in the last few decades, the range of levels of education attained has become larger, which has increased social inequalities in Japan. However, many aging Japanese enroll in various education facilities, and this factor could also influence SES, although studies on this topic have not yet been performed[74].

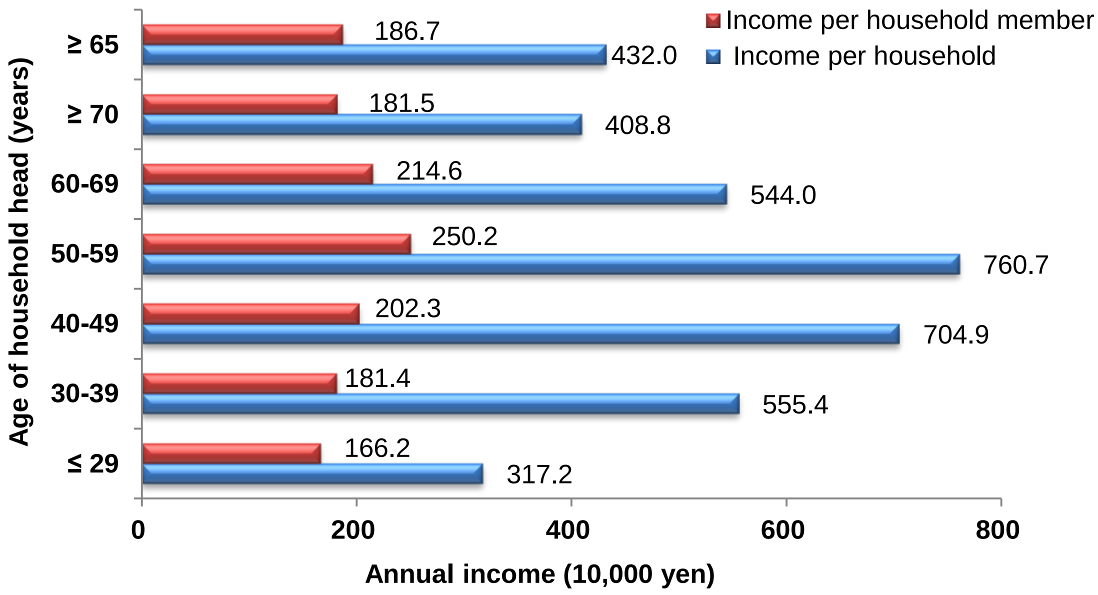

Figure 1.10: Average income per household and per household member by age group of household head, 2006. (Source: Ministry of Health, Labor and Welfare, 2006[72].)

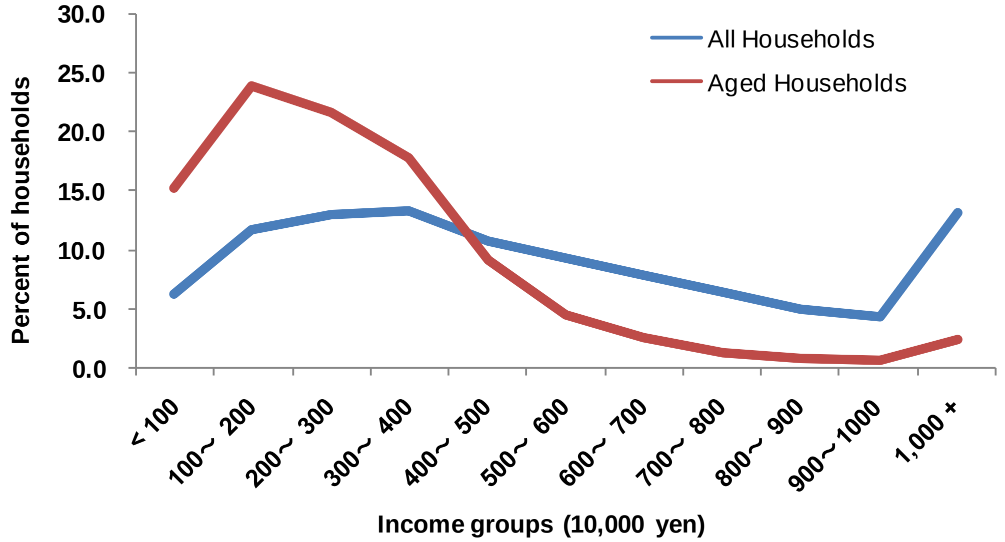

Figure 1.11: Distribution of income by all households and aged households. (Source: Source: Ministry of Health, Labor and Welfare, 2006[72].)

1.3.3 Theoretical Hypothesis about SES-HALE Associations at an Older Age

The multifaceted nature of SES and HALE needs to be considered in studies on social inequality in health. The sociological background for the analysis of SES differences on HALE in elderly individuals is the question of whether social inequality increases, decreases, or remains stable during old age (Figure 1.12).

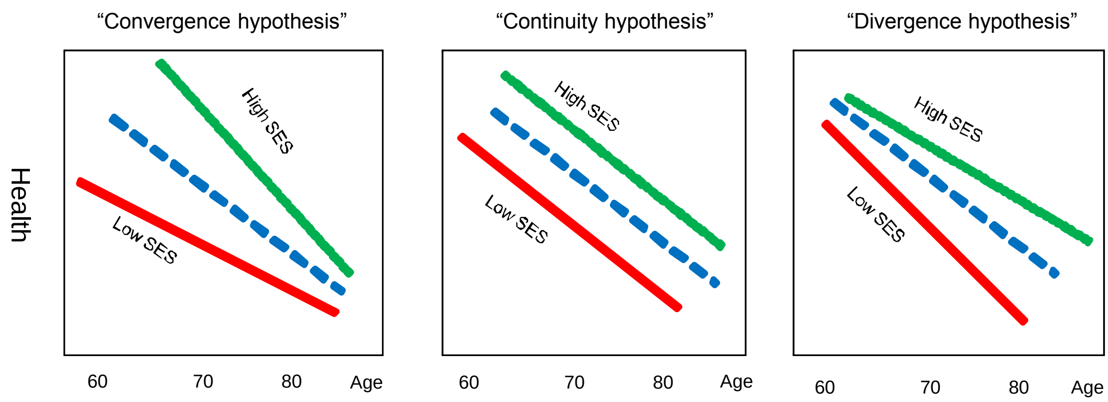

Figure 1.12: Hypotheses about SES-Health associations at older age.

Convergence Hypothesis – "Status Leveling Hypothesis"

Representatives of the age-as-leveler hypothesis suggest that health differentials by SES are largest in prime age and then converge at older ages due to a variety of factors[75, 76]. Biological deterioration in later life could accelerate health decline of high SES, leading to an override of the significance of social factors and thus to a convergence of the status groups[77]. Another possibility is that in some cases, selective survival might eliminate SES differences in health in later life. A different assumption within the status-leveling hypothesis is that the welfare state actually reduces socioeconomic differences in old age through benefits and social security[78]. This is also called the *Redistribution Hypothesis*, which stresses that in many industrial countries, inequality among the elderly is less pronounced than among younger groups[79].

Continuity Hypothesis – "Status Maintenance Hypothesis"

The influence of SES on health in later life has also been characterized by continuity, which is indicated by little age differences or stability in the SES-HALE relationship. Status maintenance is based primarily on the influence of the working age on the retirement age through external structures in which the individual has a persisting position. Secondly, status maintenance can be based on internal dispositions such as learning behavior, habits, and one's own self-concept[79, 80].

Divergence Hypothesis – "Cumulative Advantage Hypothesis"

Other researchers have provided empirical evidence for divergence in health disparities by SES in later life, which suggests that social inequalities in health may be due to the cumulative effects of disadvantage over the life course, resulting in enhanced, rather than diminished, SES in older ages compared to middle life[81, 82]. Another aspect that contributes to an accumulation of inequality is the fact that certain inequalities only become visible and effective with a poor health status, for example, the exposure to one environmental hazard is likely to be combined with exposure to other hazards, and these exposures are likely to accumulate over the course of a lifetime[83].

The three hypotheses about how SES inequality could change with increasing age (leveling, maintenance, and accumulation) are not mutually exclusive. Some pathways that lead to a leveling of social inequality with age may exist together with other processes that increase inequality. For example, most of the studies conducted in the United States provided strong evidence in favor of the leveling hypothesis, because the American health care system is characterized by socially-patterned health insurance coverage up to the age of 65 years, when virtually all citizens receive basic health insurance through Medicare[84]. Furthermore, due to the large social inequalities in health during midlife in the United States, the SES disparities on health might be attenuated in old age due to a strong influence of selected mortality in earlier stages of life[85].

In summary, given the ambiguity of the extant literature, we cannot predict with confidence whether SES differentials in health will diminish, continue, or grow at older ages. Because the use of SES and health indicators may differ in various social contexts, more empirical evidence on the age patterns of SES differentials in HALE can help us evaluate the relative merit and applicability of the convergence hypothesis versus the divergence hypothesis[86].

1.3.4 Literature Review on SES-HALE Mechanisms

This dissertation systematically reviews the empirical literature on SES effects on HALE within and outside Japan. Most of the academic researchers have shown that the SES-HALE gradient remains in older people, and also appears to influence multiple dimensions of health, including physical functioning, comorbidity, and SRH. The explanations of good health status and long life expectancy among high SES individuals were classified into conceptually distinct mechanisms, in which the impact of SES was assumed to either directly influence HALE or indirectly impact HALE.

Direct SES-HALE Mechanism

Education most likely affects health directly, indicating that the lower a person's level of education, the more likely he/she will have a higher risk of chronic diseases and disability. Further, it is also clear that people at a low-income level have multiple health problems, leading to poor SRH.

At the national level, a study in the UK revealed that social class, unemployment rate, and the percentage of the non-white population were the primary variables associated with differences in disability-adjusted life expectancy (DALE) at birth[87]. Another similar study conducted in Spain found that illiteracy rate and the percentage of smokers in the population were the primary factors associated with the geographical variation of DALE[88]. An ecological study in Japan found that among 181 factors related to socio-demographic factors, 3 factors could potentially explain the differences in DFLE of the Japanese older population: good self-rated health status, a high proportion of older workers, and the presence of a large number of public health nurses[89].

At the individual level, a cohort study among 110,790 individuals age 40–79 years in 45 areas in Japan showed that individuals with low levels of education had an increased overall risk of death (16% and 26% increased risk for men and women, respectively)[90]. The results of another cross-sectional research study on a Japanese sample of 80,899 persons > 15 years old in 1995 demonstrated that compared to people whose household income was ≥ 5 million yen, those whose household income was < 1.5 million yen were 1.93 times more likely to perceive their own health as the worst[91]. By surveying Japanese workers age 20–40 years, Togari and Yamazaki[92] found an association between poor sense of coherence (SOC) and occupation (non-temporary < temporary and professional < white-collar < blue-collar) and an association between the poorest SOC and unemployment and lower education levels.

These direct SES effect on HALE results indicate that health inequalities exist in Japan. Thus, social and political initiatives are needed to correct these social inequities.

Indirect SES-HALE Mechanism

Evidence of the socioeconomic gradient in health has pushed for explanations that go beyond the direct relationship between SES and HALE. For example, education is believed to promote good health not only by generating economic resources (income and employment) but also by providing social-psychological resources: knowledge and skills by which people are able to better self-manage illness and disease, healthy behaviors, ability to cope with stress, perceptions of control, and social support. Income has been shown to promote good health by affecting nutrition, housing quality, exposure to environmental hazards, and access to adequate physical and mental health care.

According to Mirowsky and Ross[93], increasing educational attainment improves health by increasing individual agency, self-efficacy, and problem-solving capacity, all of which promote a healthy lifestyle. In addition, education level is less likely to be affected by health impairments that developed in adulthood compared to other indicators of SES, such as occupation or income[94]. However, recent research suggests that income is associated more strongly with progression (rather than onset) of disease than with education, suggesting that economic resources promote health in part by increasing the abilities to pay for medical care and to acquire transportation to care facilities[95,96].

In Japan, Fujino et al.[90] examined the association between educational level and major causes of death in a prospective cohort study. The findings suggest that lower levels of education can lead to insecure income, hazardous work conditions, and poor housing, which can increase the risk of death due to external causes. Previous findings from another cohort study of 1,266 Japanese male office workers age 35–59 years identified smoking as a risk factor for type 2 diabetes, and therefore, the significant inverse relationship between diabetes and education might be partly explained by the association between smoking and education[97].

A few cohort studies conducted in Japan using structural equation modeling (SEM) were conducted to explore the indirect relationships between SES and HALE. Hoshi et al. [98] discovered that health and life conditions were not determined by current dietary and lifestyle habits, which many studies showed. However, the condition were more directly affected by three health-related dimensions three years earlier, and indirectly affected by educational attainment and previous annual income as well. Using the same data, Takahashi et al.[99] suggested that decreases in yearly income could disrupt the balance of health of older people via decreasing daily activity and poor social support. Bosako et al.[100] concluded that SES affected the duration of survival both directly and indirectly via three health factors (physical, mental, and social), and that the indirect effects were stronger than the direct effects.

SES-HALE Mechanism by Gender

Longitudinal comparative data on life expectancy indicate a central societal division between men and women (on average, women live longer than men). Biology is only one of a group of factors that shape health outcomes, and it might not be the most important one. As Waldron[101] argues in her "Gender Role Modernization Thesis," structural-social changes have led to social, cultural, and economic changes that are shaping a more healthy life — on average, women smoke and drink less than men and are less involved in physically demanding and risky jobs.

Gender differences in the association between income and health have also been reported in a recent cross-sectional study among 9,650 participants age 47–77 years[102]. Men tended to report more fair or poor health as household income decreased, while the results for women differed. In a study of 2,200 elderly Japanese, Liang et al. [103] reported that in contrast to Western countries, an educational crossover exists only among elderly men, which may be due to gender and SES differences in causes of death, morbidity, and health behavior. Yamazaki et al.[104] examined the association between annual household income and the eight scale scores of the Medical Outcomes Study Short Form-36 Health Survey (SF-36) as a quantifier of Health Related Quality of Life in Japan. A total of 3,395 people age ≥ 16 years were selected from the entire population of Japan using stratified-random sampling method. Results showed that a strong association existed between annual household income and SF-36 scores among men, but there was only a limited association among women. Fukuda et al.[105] noted that the relationship between mortality and the education-income index was stronger for males than for females, and that gender differences in the association between mortality and municipal SES were due to substantially different patterns in the primary causes of death between males and females.

SES-HALE Mechanism by Age

Studies that address different health dimensions suggest that social inequalities might develop differently according to the health indicator considered. For example, as Lampert[106] has shown, using a sample age 70 to 100+ years, small socioeconomic differences in physical aspects of health up to the age of 90 years were followed by significant differences in individuals ≥ 90 years old. A contrasting picture emerged for functional health, in which socioeconomic differences were significant at age 70–79 years and disappeared in older age groups[107]. One study using several SES and health indicators and a sample limited to individuals ≥ 60 years old showed only slight age variation in the effect of SES on health in Germany, supporting the continuity hypothesis[108]. In Japan, a study conducted by Liang et al.[103] showed that educational differences in mortality tend to converge in the 70- to 79-year-old age group. The authors also confirmed, in the Japanese context, that the effect of SES on health was small in early adulthood, greatest in middle and early old age, and relatively small again in late old age. One of the few studies of this issue indicated that while health behavior mediated the association between education and functional health in 55- to 70-year-old people, psychosocial factors became more relevant for older people[109].

SES-HALE Mechanism by Geographic Location

Socially disadvantaged areas were reported to be associated with higher mortality, morbidity, and health related risk behaviors. A series of ecological studies using the Japanese municipal statistics on SES and mortality by Fukuda et al. suggested that a lower SES was related to higher mortality. The first study classified the municipalities across the country into quintiles according to the index of SES obtained from income and education, and found that mortality gradient by SES and excess deaths in the lower SES quintiles due to injury and suicide markedly increased from the 1973–1977 to

1993–1998 periods for both males and females[105]. Another related ecological study found that health expectancy at age 65 years was significantly positively correlated with per capita income in municipalities across Japan. The relationship was stronger in larger municipalities (i.e., those with populations of more than 100,000 individuals) than in small- and medium-sized municipalities. The results of this study indicated that the health status of older people is substantially decreased by disadvantageous socioeconomic conditions[110].

1.4 Study Objectives, Originality and Significance

1.4.1 A Comprehensive View of Previous Studies

Findings from previous studies enhanced our understanding of the effect of SES on HALE, and provided recommendations for improving HALE among elderly people. Although there is a well-established relationship between SES and HALE according to which people with higher SES live longer in good health compared to people with lower SES, inconsistent results were reported in previous studies due to different research designs and cultures. In addition, although several recent studies examined SES and HALE among the Japanese, all of them focused on special populations such as the elderly living alone, elderly with impairment, or patients with certain diseases. To date, few studies have investigated the association between SES and HALE among elderly people in large-scale follow-up studies in Japan. Specifically, previous research has had critical limitations in the attempts to understand how the SES affects HALE of individual elderly people in Japan, as follows.

(1) Past research has calculated HALE using various methods that account for both mortality and morbidity in a single index within a representative sample; however, few detailed studies objectively and systematically assessed the HALE as living longer and healthier at the individual level, particularly for elderly people.

(2) Previous studies considered physical functioning, illness, LTC need, and SRH as HALE measures; however, the structural causal relationship among them was overlooked. In addition, in previous studies that evaluated the relationships between individual physical health status and SRH, or mortality, they limited their assessments to

combine all the variables to explore their underlying relationships.

(3) A large number of previous studies explored the relationship between SES and HALE, and showed direct and indirect effects by survival analysis or logistic regression. Few studies adequately incorporated multiple factors or the relationships among these factors, which have been found to be significantly related to HALE of the elderly by using the SEM to analyze and show the inter-relationships.

(4) A few of the previous studies explored the SES effect on HALE by controlling certain demographic variables, such as age and gender. However, less attention has been given to the theoretically and practically relevant question of whether SES and HALE associations differ in population subgroups, such as those that differ by gender, age, and location.

1.4.2 Study Objectives

The purpose of this empirical study is to examine the structural relationships among SES, physical health, LTC level, and HALE of the Japanese elderly. More precisely, this dissertation aims to explore the SES-HALE mechanism of Japanese elderly individuals. It is premised that SES is directly or indirectly related to the HALE of Japanese elderly depending on gender, age, and geographic location. The following three objectives are established:

(1) Describe the characteristics of SES, HALE, LTC, and physical health status among Japanese elderly people;

(2) Assess direct and indirect effects of SES on physical health, LTC, and HALE of Japanese elderly people;

(3) Explore the SES-HALE mechanism differences by gender, age, and geographic location of Japanese elderly people.

1.4.3 Study Originality and Significance

Due to a paucity of empirical studies on HALE of elderly people, there is a knowledge gap in the understanding of whether or not elderly people live longer in good health. Japan ranks as having the highest HALE in the world; thus, this study may be able to bridge the gap by clarifying the measurement of HALE and estimating a series of best-fit models of Japanese elderly people.

Furthermore, for many years, diverse conceptual and theoretical models have been proposed to explore the social determinants of health status of older individuals. Based on large-scale surveys and the advanced statistical software (e.g. SPSS and SEM for Windows), empirical study represents an effort to investigate the mechanism by which SES takes multiple pathways to exert direct and indirect effects on the HALE among Japanese elderly people, considering the differences by population subgroups, including gender, age, and geographic location.

This dissertation used data from 1995–2007 at both prefectural and individual levels; during this period, Japan transitioned from an aged society to a super-aged society. This study can provide valuable information on how SES affects HALE of Japanese elderly people, which could help social workers develop planning interventions and deliver effective services to improve elderly people’s QOL by considering their individual differences and needs. Furthermore, implications for reducing the LTC/support cost in the future can be elicited.

1.5 Hypothetical Model

Based on the related literature review, a model illustrating the structural relationships of SES, physical health, LTC level, and HALE to be tested in this study is proposed in Figure 1.13. This model includes three latent variables (SES, physical health status, and HALE) in the circles and one observed variable (LTC level) in the rectangle. A one-way arrow between two variables indicates a postulated direct influence of one variable on another. The following hypotheses (H1—H8) are established in the proposed study with various latent constructs.

H1: The level of SES will be positively associated with HALE directly (Figure 1.13: path ①);

H2: The level of SES will be negatively associated with the LTC level directly (Figure 1.13: path ②);

H3: The level of SES will be associated with the physical health status directly (Figure 1.13: path ③);

H4: The physical health status will affect the LTC level directly (Figure 1.13: path ④);

H5: The level of SES will affect HALE indirectly via LTC level (Figure 1.13: path ②—⑤);

H6: The level of SES will affect HALE indirectly via physical health status (Figure 1.13: path ③—⑥);

H7: The level of SES will affect HALE indirectly via physical health and LTC level (Figure 1.13: path ③—④—⑤);

H8: Gender, age, and geographic differences exist in the structural relationships among SES, physical health, LTC level, and HALE.

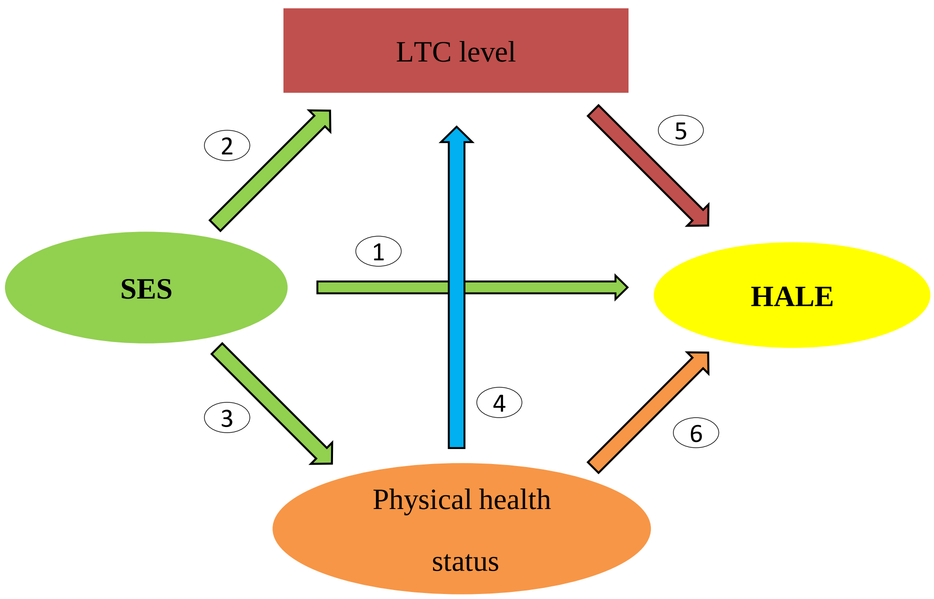

Figure 1.13: Hypothetical model of this dissertation (Yang, 2011).

1.6 Data and Methods

1.6.1 Variables and Measurement

In this dissertation, each chapter includes different research; the measures of the variables in each chapter are described below.

For the SES construct, three measured variables — income, education, and occupation — were used. Among theses, Chapter 2 uses data on per capita income, enrollment rate in higher education, and total employment rate to explain SES at the prefectural level, which were collected from government organizations and public institutions; Chapter 3 uses individual annual income to measure SES, and the data were collected by asking the respondents to choose the category that best corresponded to their and their spouse's total annual income in the questionnaire; and Chapter 4 considers annual income and educational level as two component of SES, and the data were also collected from questionnaire surveys.

Physical disability and chronic illness were considered as components of physical health status. Among these, physical disability was defined as a composite index of BADL and IADL. BADL included three items: using the toilet, taking a bath, and taking a walk outside[38], while IADL included five items: reading, grocery shopping, meal preparation, money arrangement, and insurance and pension management[111]. Chronic illness was defined as a composite index of comorbidity and degree of pain. Comorbidity was measured by asking participants whether they had been diagnosed and were currently suffering from select diseases in the questionnaire, such as hepatic disease, diabetes mellitus, cardiovascular disease, and cerebrovascular disease. The degree of pain was determined by instructing the individuals to describe the amount and area of pain (e.g., waist, arthritis, ankle, foot, head, shoulder, or other) they were currently experiencing. All data were collected on an individual level and are discussed in Chapters 3 and 4.

LTC level was an observed variable; Chapter 2 uses the rate of certification for LTC need to measure the LTC level in each prefecture. Chapter 3 does not discuss this variable, because the survey was conducted from 1998–2000, when LTC insurance had not yet been implemented in Japan. In Chapter 4, the category certification of LTC was evaluated according to the six levels designated by the Japanese Ministry of Health, Labor and Welfare, which include one support level and five care levels.

This dissertation defined HALE as the length of life in good health, and two indicators were used: mortality and SRH. Chapter 2 uses the prefectural mortality, including age-adjusted death rates for males, females, and individuals ≥ 65 years old; Chapters 3 and 4 use the individual survival time and SRH to measure HALE. Based on the vital status (alive or deceased) obtained from the municipal resident' registry, survival time was defined as the number of days alive during the survey period. SRH of the participants in the survey was assessed by a single question: "How would you rate your general health: very good, good, fair, or poor?"

1.6.2 Data Analysis Methods

In this study, the collected prefectural-level and individual-level data were analyzed by using quantitative methods. Four statistical methods were used including correlation analysis, factor analysis, survival analysis, and structural equation modeling (SEM). All the analyses were performed by using the Windows software SPSS 19.0 and AMOS 17.0.

The final and most important objective is to test the proposed model as mentioned before by SEM, as the other three methods can provide only basic results. SEM can help to understand what factors are significantly associated with HALE, as well as the pathways from SES to HALE among the study participants. The most common method for SEM is maximum likelihood (ML) estimation. A key assumption for this method is multivariate normality for exogenous variables. During the parameters' estimation in SEM, the optimization algorithm was implemented with no-missing-data parameters, and a possible presence of multicollinearity among predictor variables is also considered. The SEM aims to provide the best estimates of the parameters based on minimizing a function that indexes how well the model fits. By using AMOS, a set of indices can be provided to measure the model's goodness-of-fit, including the CMIN (χ^2), Normalized Fit Index (NFI), Comparative Fit Index (CFI), Incremental Fit Index (IFI), and root mean square error of approximation (RMSEA). A model was considered to have a good fit when the NFI, CFI, and IFI were > 0.90 and the RMSEA was < 0.05.

In addition, multi-group analysis was used to determine whether or not the relationships hypothesized in a model will differ based on the value of gender, age, and geographic location. The test statistic is a critical ratio (CR), which presents the ratio between parameter estimates and their standard error. It is similar to the *z*-statistic in testing the regression coefficient, which is statistically different from zero if CR > ± 1.96 based on a 0.05 significance level by a two-tailed test. Non-significant regression weights can be considered unimportant in the model and can thus be eliminated[112].

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Chapter 2

Prefectural Mortality in Relationship to Socioeconomic Status and Long-term Care in Japan

2.1 Introduction

Populations are aging and life expectancy continues to increase throughout most of the world due to the profound changes in the prevailing patterns of disease and morbidity. As one of the fastest aging developed countries, Japan has the longest life expectancy and healthy life expectancy (HALE) at birth in the world. These achievements in the Japanese population, particularly in the 1960s and 1970s, are suggested to be based not only on improvement in the standards of living due to economic growth but also on a relatively smaller socioeconomic disparity[1, 2]. Nonetheless, significant geographical variation in health levels is found even in Japan. According to the prefectural estimates published by the Ministry of Health, Labour and Welfare (2012), HALE at birth by prefecture was found to vary from 68.95 (Aomori Prefecture) to 71.74 (Aichi Prefecture) for males and from 72.37 (Shiga Prefecture) to 75.32 (Shizuoka Prefecture) for females in 2010 (Figure 2.1).

Variations in individual health levels have been explained by the coexistence of multiple factors of genetic and constitutional variations, lifestyle, working conditions, education, income, and other factors. However, when health differences are: (1) systematic, (2) socially produced (and, therefore, modifiable), and (3) unfair, such variation in an individual's health can be viewed as a form of social inequality, i.e., health inequality[3]. Recently, Joumard et al.[4] reviewed the explanatory factors highlighted in the literature on life expectancy variations between and within societies. These researchers considered health status as determined by a combination of health care resources, lifestyle, and socioeconomic factors. Among them, income per capita, education, and pollution are the socioeconomic factors most frequently included in empirical work. Other factors, such as poverty, urbanization, income distribution, unemployment, ethnic origin and/or religion, and occupational status, are also included in a few studies. In Japan, a relationship between health and geographic area characteristics has been elucidated. Systematic studies using municipal data regarding all causes and cause-specific mortality along with several socioeconomic indicators showed significant relationships between regional mortality and socioeconomic characteristics[5-7]. Socioeconomic status (SES) reflects different aspects of social stratification, and people with low SES have a higher mortality than those with better

SES. Because no SES index has yet been established for research in Japan, this study used the traditional SES indicators for analysis, including income, education, and occupation at the prefectural level.

A small but growing body of literature on socioeconomic inequality in morbidity among older individuals suggests that social inequality in health persists into old age. Moreover, frailty among elderly individuals is associated with their SES and is strongly associated with their health- and home-care utilization[8]. SES indicators such as education, income, wealth, and homeownership are predictors of long-term care (LTC) use; however, the evidence for each indicator being a predictor of LTC is inconclusive. For example, the income effect refers to the possibility that people with a higher income might find it easier to pay for LTC, and might therefore, *ceteris paribus*, be more inclined to enter residential care. However, a higher income might also facilitate access to home care services and might therefore assist in delaying residential care entry[9]. In 2000, the Japanese government introduced LTC insurance for older people requiring nursing care, and citizens age ≥ 40 years can receive insurance benefits after application and certification that they require such care. Although the costs of LTC are covered by public programs for people regardless of their income level, few studies have been conducted on the association between SES and the LTC application rate. Since LTC insurance unions are managed by municipalities in Japan, the LTC data require an application rate so that they can be collected at the prefectural level.

The study of the socioeconomic factors that determine prefectural mortality variations in Japan is a matter of great interest, because it helps to provide rational guidance on possible activities to reduce such differences and, in short, to increase the level of health in the whole population. The purposes of this study were to explore the distribution of mortality, LTC, and SES among prefectures in Japan from 1995–2005, and to elucidate the association between SES, LTC, and mortality indictors by using aggregated panel data. Finally, time trends and gender differences were explored.

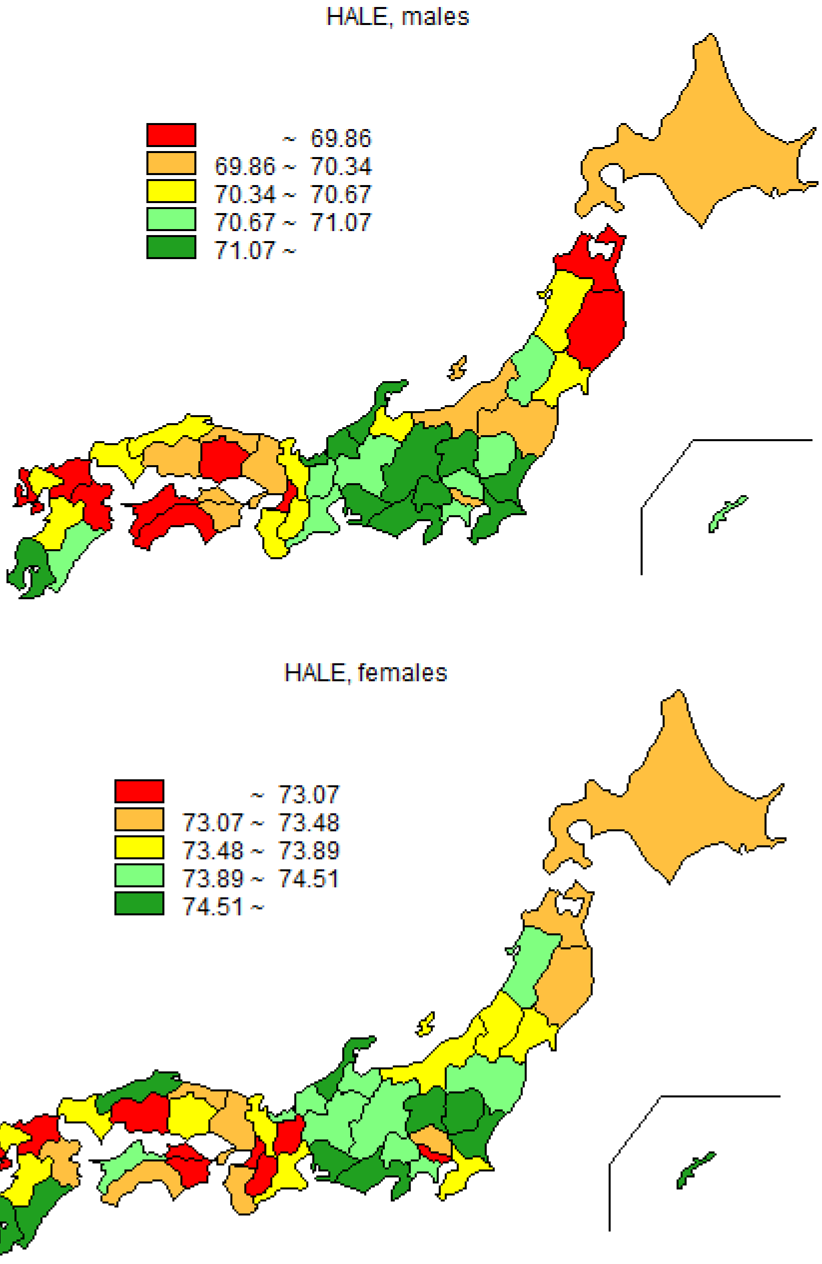

Figure 2.1: Healthy life expectancy (HALE) at birth by gender in 2010. (Source: Ministry of Internal Affairs and Communications, 2012[10].)

2.2. Methods

2.2.1 Study Units

According to Local Autonomy Law, local public entities in Japan are divided into two categories. The prefectures of Japan are the country's 47 first-order subnational jurisdictions on a state or provincial level: 1 "metropolis" (in Japanese, *"to"*), Tokyo; 1 "circuit/territory" (*"do"*), Hokkaido; 2 urban prefectures (*"fu"*), Osaka and Kyoto; and 43 other prefectures (*"ken"*). There are currently 47 prefectures, increased from 46 in 1972 with the reversion of the Okinawa Prefectures to Japan. Another category consists of cities, towns, and villages (*"shi," "cho,"* and *"son"*). The 47 prefectures in Japan were used as units of analysis, which are grouped into nine regions based on their geographic divisions: Hokkaido, Tohoku, Kanto, Chubu, Kansai, Chugoku, Shikoku, Kyushu, and Okinawa.

2.2.2 Data Collection

This study adopts a prefecture-based data analysis, considering the influence of SES on mortality and LTC. We selected seven indicators obtained from multiple data sources, which were published by government organizations and public institutions for specific years: 1995, 2000, and 2005. Every conceivable variable of interest was considered.

Mortality as a dependent variable was explained by a series of indicators in this study: age-adjusted death rate (per 1,000 people) for males, age-adjusted death rate (per 1,000 people) for females, and death rate for people ≥ 65 years (per 1,000 people). As the age distributions were different over the study period, age-adjusted death rates by gender were calculated using Population Censuses data (Ministry of Internal Affairs and Communication) in 1995, 2000, and 2005; however, the death rates of people ≥ 65 years old were available only for 2000 and 2005.

Rates of certification for LTC need were calculated by dividing the number of applications for certification of need for LTC (or support) by the number of insured people age ≥ 65 years. Data were not available in 1995, because LTC insurance was not introduced until April 2000. Data were collected from the Report on Long-term Care Insurance Operation, Ministry of Health, Labour and Welfare in 2000 and 2005.

Three prefectural SES indicators were used as independent variables: enrollment rates in higher education (%), per capita income (1,000 yen), and total employment rate (%). Data for all indicators were obtained in 1995, 2000, and 2005. Enrollment rates in higher education referred to the percentage of upper secondary school graduates that moved on to higher education, which were collected from School Basic Survey, Ministry of Education, Culture, Sports, Science and Technology. Per capita income was calculated by dividing the aggregated annual taxable income by the total prefectural population from National Accounts of Japan, Cabinet Office. Total employment rates reflected the percentage of employed people age 15–65 years in the total workforce, which were collected from Population Census, Ministry of Internal Affairs and Communication.

2.2.3 Statistical Methods

Statistical analysis was conducted separately for each of the dependent variables for each year. First, basic descriptive statistics were calculated. For descriptive observations and screening purpose, variations of the selected variables in different years were measured, including the mean, minimum, maximum, standard deviation (SD), and coefficient of variance (CV). Then, Pearson's correlation coefficients between mortality, LTC, and the composite indices of socioeconomic factors were calculated. Third, variables showing a statistically significant association with dependent variables in different years were used in linear regression analysis. The regression model described the linear association between a single SES indicator, LTC application rate, and mortality. Considering the multicollinearity effects among the three independent variables, only the simple (univariate) regression analysis was applied. Various tests were then employed to determine whether the model is satisfactory. If the model is deemed satisfactory, the estimated regression equation can be used to predict a value of each dependent variable given known values of the independent variable.

The quintile distributions of the main variables are presented using the Map Win program. All variables used contained no missing data. All *p* values are two-tailed. Data analyses were performed using the statistical package SPSS 19.0 for Windows.

2.3 Results

2.3.1 Descriptive Characteristics

The mortality, SES, and LTC characteristics of the 47 prefectures are summarized in Tables 2.1, 2.2, and 2.3 in 1995, 2000, and 2005, respectively. From 1995–2005, the average levels (mean) of three variables were found to continuously increase: death rate of individuals ≥ 65 years old, rate of certification for LTC need, and enrollment rate in higher education; in contrast, four variables were found to continuously decrease: age-adjusted death rate of both genders, prefectural per capita income, and total employment rate. Large geographic variations in select variables were observed in each year. For example, the age-adjusted death rate of the 47 prefectures in 2005 ranged from 5.39 to 7.33 for men, 2.71 to 3.24 for women, and 31.18 to 38.22 for individuals age ≥ 65 years.

Figures 2.2–2.7 show the distribution of mortality, SES, and LTC application rate in the 47 prefectures in 1995, 2000, and 2005 by Map Win, respectively. Each map shows the clear geographical difference of each indicator. In accordance with the CV, the variations of death rate of people age ≥ 65 years and per capita income continuously widened among the 47 prefectures; in contrast, the variations in age-adjusted death rates for females, rate of certification for LTC need, and enrollment rate in higher education narrowed from 1995–2005 (Tables 2.1, 2.2, and 2.3).

Based on the quintile distribution data, each SES indicator was divided into five levels from lowest (I) to highest (V). The mean and SD of mortality and LTC application rate by different levels of education, income, and employment in 1995, 2000, and 2005 are shown in Tables 2.4, 2.5, and 2.6, respectively. The mean and SD of mortality by different LTC application level is shown in Table 2.7.

Table 2.1: Prefectural mortality, SES, and LTC characteristics of Japan in 1995.

	Mean	Minimum	Maximum	SD	CV
Mortality					
Age-adjusted death rate, males	7.16	6.18	8.62	0.41	5.77
Age-adjusted death rate, females	3.78	3.23	5.01	0.26	6.74
Death rate of people ≥ 65 years old	—	—	—	—	—
LTC					
Rate of certification for LTC need	—	—	—	—	—
SES					
Enrollment rate in higher education	37.00	22.90	47.20	6.62	17.88
Prefectural per capita income	2867.70	2136.00	4273.00	397.79	13.87
Total employment rate	63.60	58.30	68.00	2.32	3.65

Table 2.2: Prefectural mortality, SES, and LTC characteristics of Japan in 2000.

	Mean	Minimum	Maximum	SD	CV
Mortality					
Age-adjusted death rate, males	6.36	5.80	7.56	0.32	5.07
Age-adjusted death rate, females	3.20	2.87	3.48	0.15	4.72
Death rate of people ≥ 65 years old	34.82	32.04	37.24	1.21	3.47
LTC					
Rate of certification for LTC need	11.49	8.27	16.23	1.81	15.77
SES					
Enrollment rate in higher education	43.64	31.10	55.60	6.78	15.53
Prefectural per capita income	2866.64	2106.00	4573.00	404.24	14.10
Total employment rate	61.74	56.90	66.10	2.27	3.68

Table 2.3: Prefectural mortality, SES, and LTC characteristics of Japan in 2005.

	Mean	Minimum	Maximum	SD	CV
Mortality					
Age-adjusted death rate, males	5.98	5.39	7.33	0.34	5.64
Age-adjusted death rate, females	2.96	2.71	3.24	0.13	4.52
Death rate of people ≥ 65 years old	35.50	31.18	38.22	1.69	4.77
LTC					
Rate of certification for LTC need	16.56	12.70	20.93	1.96	11.83
SES					
Enrollment rate in higher education	45.48	31.10	58.40	6.71	14.74
Prefectural per capita income	2733.28	2040.00	4497.00	431.52	15.79
Total employment rate	61.10	56.40	64.90	2.05	3.36

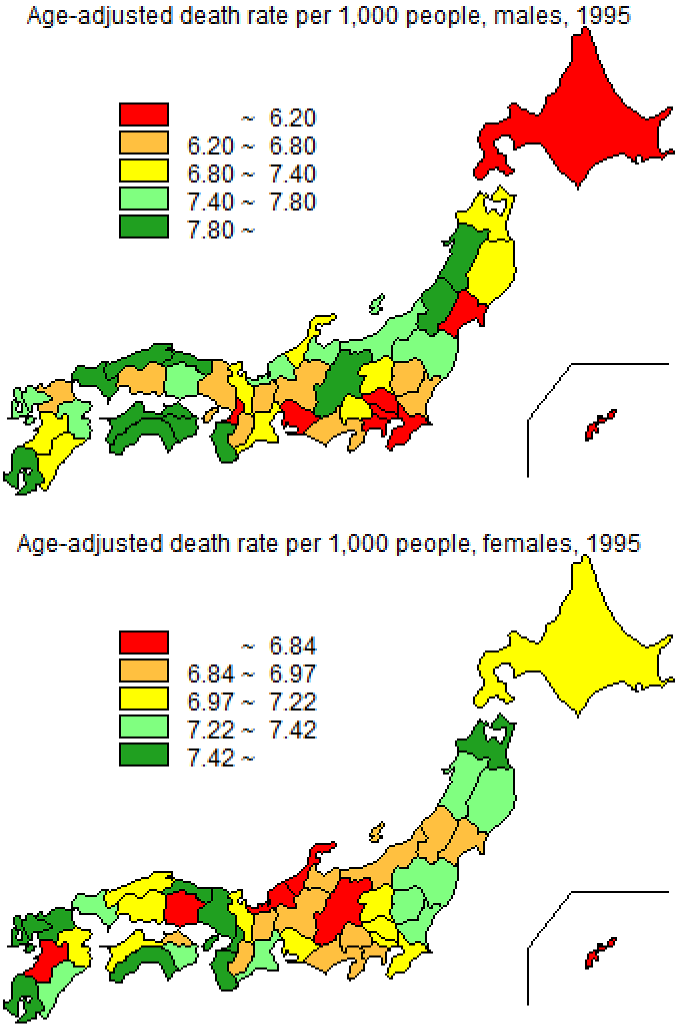

Figure 2.2: Distributions of prefectural mortality of Japan in 1995.

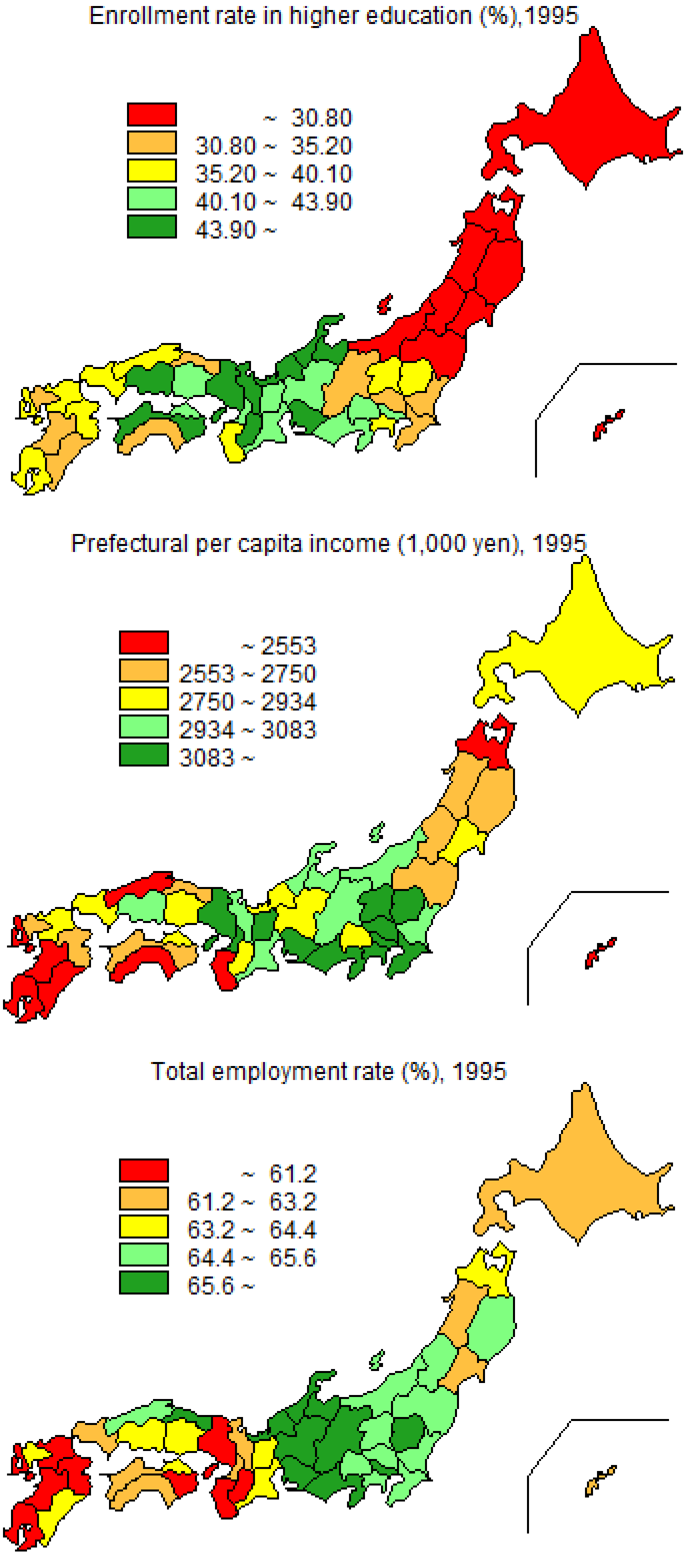

Figure 2.3: Distributions of prefectural SES of Japan in 1995.

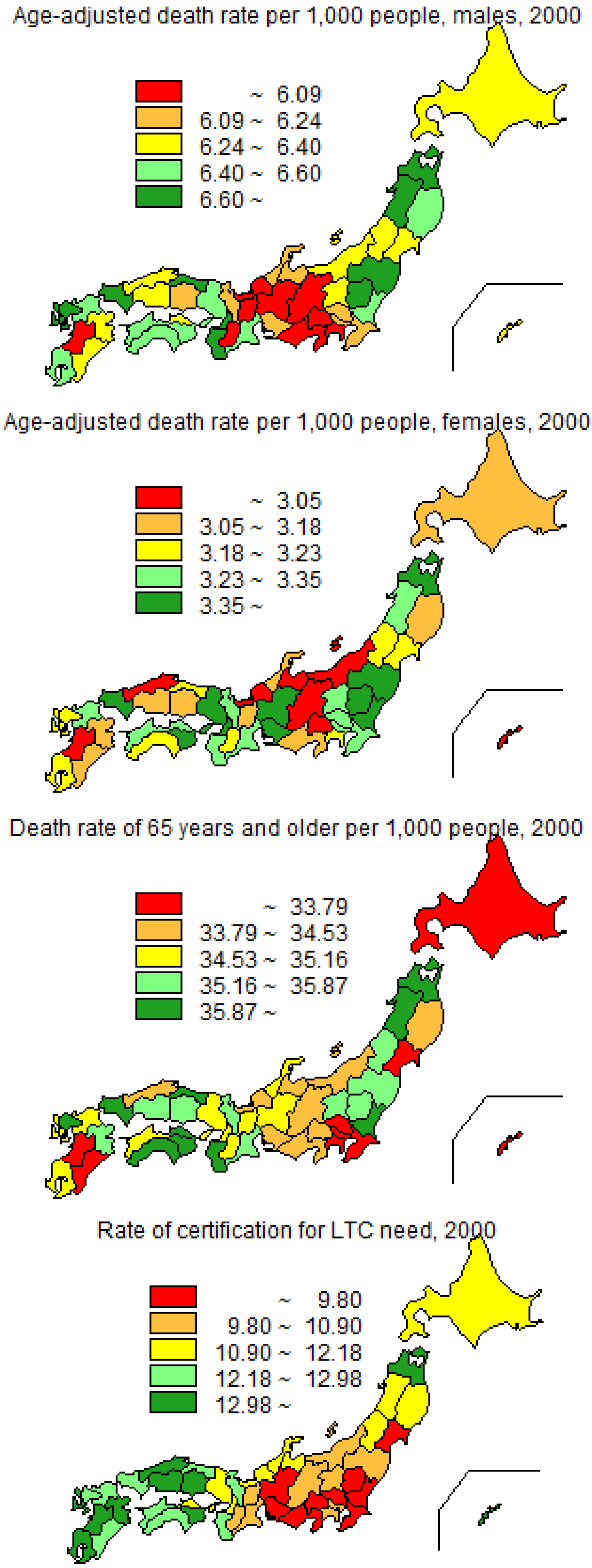

Figure 2.4: Distributions of prefectural mortality and LTC of Japan in 2000.

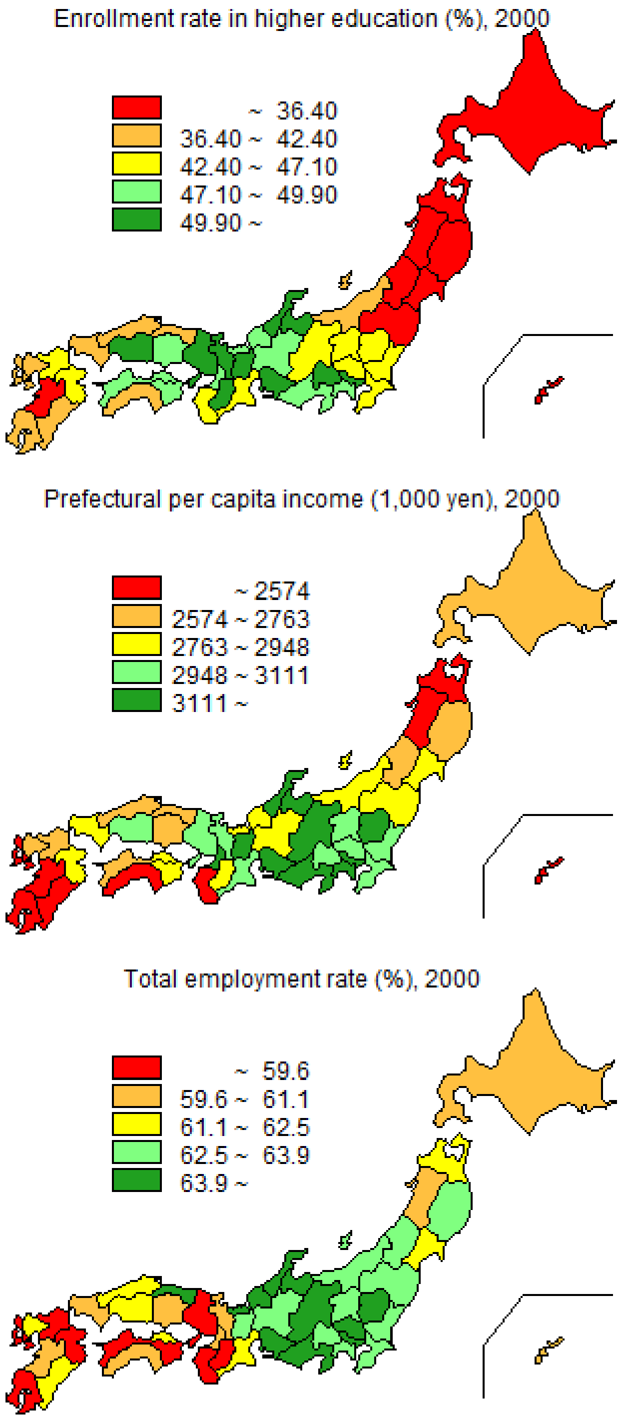

Figure 2.5: Distributions of prefectural SES of Japan in 2000.

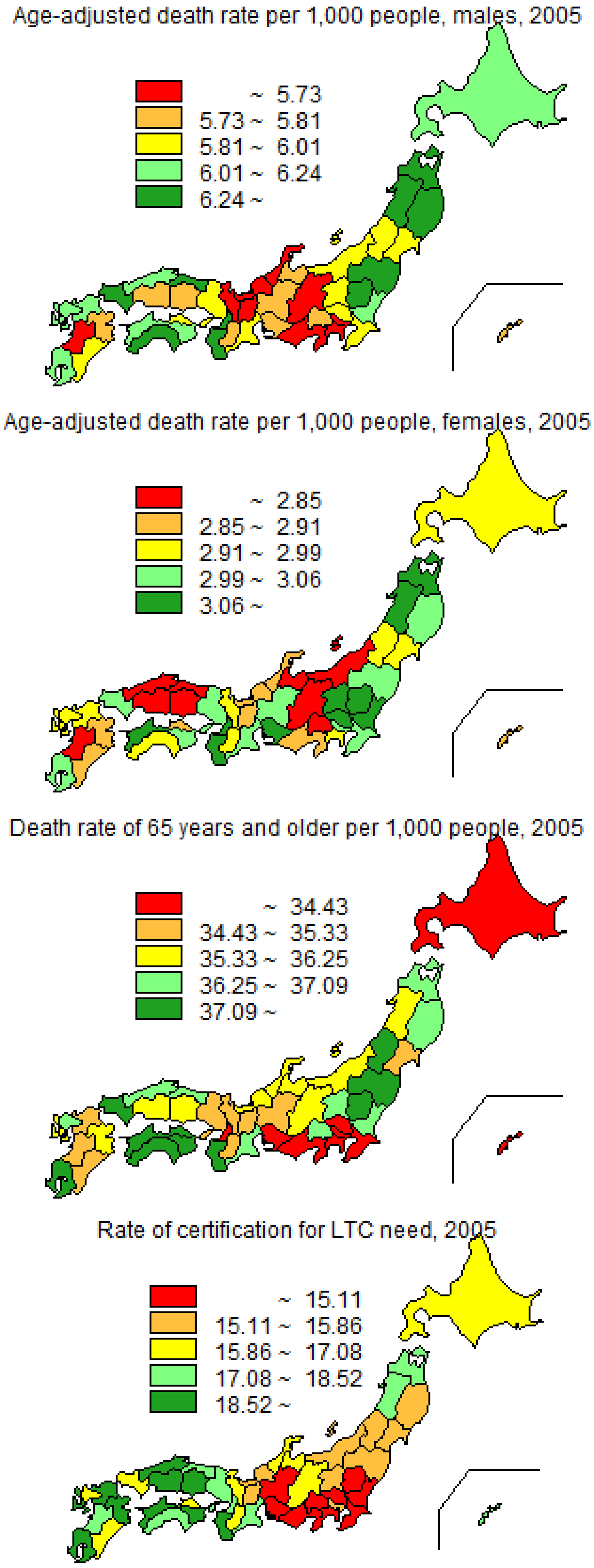

Figure 2.6: Distributions of prefectural mortality and LTC of Japan in 2005.

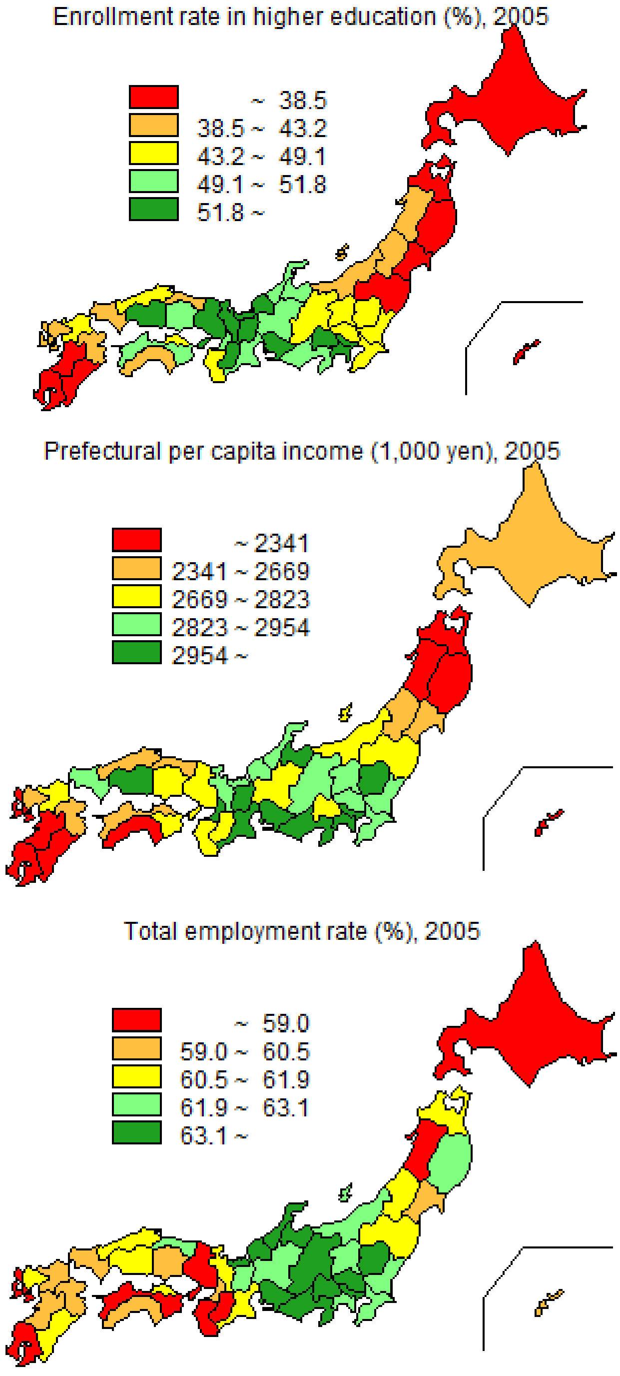

Figure 2.7: Distributions of prefectural SES of Japan in 2005.

Table 2.4: Descriptive characteristics of mortality and LTC indicators by prefectural education levels in Japan.

Year	Mortality and LTC indicators	Enrollment rate in higher education: Mean (SD)					Corrlation coefficient
		Ⅰ	Ⅱ	Ⅲ	Ⅳ	Ⅴ	
1995	Age-adjusted death rate, males	7.24 (0.44)	7.18 (0.44)	7.28 (0.31)	6.96 (0.18)	7.14 (0.59)	-0.076
	Age-adjusted death rate, females	3.71 (0.21)	3.77 (0.22)	3.83 (0.18)	3.76 (0.15)	3.87 (0.45)	0.239
2000	Age-adjusted death rate, males	6.48 (0.44)	6.54 (0.20)	6.33 (0.32)	6.26 (0.30)	6.17 (0.13)	-0.399**
	Age-adjusted death rate, females	3.17 (0.17)	3.19 (0.14)	3.28 (0.14)	3.19 (0.17)	3.19 (0.14)	0.088
	Death rate of people ≥ 65 years old	34.12 (1.29)	35.43 (1.28)	35.27 (1.12)	34.78 (1.38)	34.66 (0.51)	0.105
	Rate of certification for LTC need	11.88 (1.88)	12.65 (2.02)	10.6 (1.88)	11.49 (1.53)	10.97 (1.31)	-0.287
2005	Age-adjusted death rate, males	6.22 (0.49)	6.12 (0.22)	5.96 (0.27)	5.86 (0.24)	5.73 (0.14)	-0.502**
	Age-adjusted death rate, females	2.98 (0.12)	2.88 (0.12)	3.05 (0.15)	2.94 (0.14)	2.94 (0.10)	0.007
	Death rate of people ≥ 65 years old	35.37 (1.78)	36.60 (0.73)	35.84 (2.08)	34.88 (1.95)	34.78 (1.08)	-0.210
	Rate of certification for LTC need	16.79 (1.22)	17.49 (1.54)	15.60 (2.47)	16.99 (2.44)	15.99 (1.55)	-0.146

**p<0.01.

Table 2.5: Descriptive characteristics of mortality and LTC indicators by prefectural income levels in Japan.

Year	Mortality and LTC indicators	Prefectural per capita income: Mean (SD)					Corrlation coefficient
		Ⅰ	Ⅱ	Ⅲ	Ⅳ	Ⅴ	
1995	Age-adjusted death rate, males	7.34 (0.46)	7.32 (0.21)	6.95 (0.21)	7.11 (0.70)	7.11 (0.29)	-0.164
	Age-adjusted death rate, females	3.71 (0.27)	3.77 (0.06)	3.73 (0.14)	3.86 (0.50)	3.88 (0.15)	0.270
2000	Age-adjusted death rate, males	6.64 (0.43)	6.40 (0.17)	6.26 (0.26)	6.26 (0.18)	6.21 (0.32)	-0.385**
	Age-adjusted death rate, females	3.19 (0.17)	3.15 (0.12)	3.22 (0.15)	3.22 (0.14)	3.22 (0.19)	0.191
	Death rate of people ≥ 65 years old	35.05 (1.57)	34.6 (1.23)	35.42 (0.91)	34.77 (1.07)	34.14 (0.97)	-0.192
	Rate of certification for LTC need	13.41 (1.47)	11.92 (1.20)	11.57 (1.52)	10.17 (1.75)	10.14 (0.72)	-0.595**
2005	Age-adjusted death rate, males	6.27 (0.48)	5.97 (0.16)	5.94 (0.29)	5.86 (0.24)	5.83 (0.28)	-0.431**
	Age-adjusted death rate, females	2.96 (0.14)	2.90 (0.11)	2.96 (0.14)	3.00 (0.13)	3.00 (0.16)	0.107
	Death rate of people ≥ 65 years old	35.76 (1.63)	36.11 (1.33)	35.93 (1.29)	35.30 (1.83)	34.33 (2.04)	-0.352*
	Rate of certification for LTC need	17.59 (1.23)	17.40 (1.49)	16.83 (2.22)	15.35 (2.19)	15.46 (1.61)	-0.407**

*p<0.05; **p<0.01.

Table 2.6: Descriptive characteristics of mortality and LTC indicators by prefectural employment levels in Japan.

Year	Mortality and LTC indicators	Total employment rate: Mean (SD)					Corrlation coefficient
		Ⅰ	Ⅱ	Ⅲ	Ⅳ	Ⅴ	
1995	Age-adjusted death rate, males	7.35 (0.52)	7.32 (0.45)	7.11 (0.25)	7.03 (6.94)	6.94 (0.42)	−0.398**
	Age-adjusted death rate, females	3.85 (0.45)	3.80 (0.17)	3.78 (0.10)	3.76 (3.71)	3.71 (0.18)	-0.201
2000	Age-adjusted death rate, males	6.49 (0.21)	6.41 (0.32)	6.46 (0.44)	6.22 (6.19)	6.19 (0.30)	-0.365*
	Age-adjusted death rate, females	3.27 (0.08)	3.16 (0.17)	3.19 (0.16)	3.22 (3.16)	3.16 (0.18)	-0.141
	Death rate of people ≥ 65 years old	35.56 (0.94)	34.34 (1.48)	34.92 (1.38)	34.49 (34.68)	34.68 (0.93)	-0.200
	Rate of certification for LTC need	12.91 (1.48)	12.68 (1.53)	11.37 (1.56)	9.67 (10.65)	10.65 (1.18)	-0.602**
2005	Age-adjusted death rate, males	6.16 (0.19)	5.91 (0.27)	6.12 (0.46)	5.93 (5.75)	5.75 (0.25)	-0.345*
	Age-adjusted death rate, females	3.03 (0.07)	2.92 (0.12)	2.93 (0.15)	2.97 (2.95)	2.95 (0.17)	-0.173
	Death rate of people ≥ 65 years old	36.18 (1.55)	34.76 (1.59)	36.52 (0.86)	35.13 (34.73)	34.73 (1.78)	-0.195
	Rate of certification for LTC need	18.23 (1.58)	17.75 (1.14)	16.90 (1.39)	14.75 (14.94)	14.94 (1.39)	-0.691**

*p<0.05; **p<0.01.

Table 2.7: Descriptive characteristics of mortality indicators by prefectural LTC application rates in Japan.

Year	Mortality indicators	LTC application rate: Mean (SD)					Corrlation coefficient
		Ⅰ	Ⅱ	Ⅲ	Ⅳ	Ⅴ	
2000	Age-adjusted death rate, males	6.20 (0.23)	6.20 (0.23)	6.36 (0.33)	6.61 (0.14)	6.46 (0.44)	0.334**
	Age-adjusted death rate, females	3.26 (0.14)	3.18 (0.14)	3.20 (0.16)	3.24 (0.08)	3.13 (0.19)	-0.208
	Death rate of people ≥ 65 years old	34.09 (1.27)	34.78 (0.64)	34.71 (1.10)	35.97 (1.34)	34.90 (1.20)	0.303
2005	Age-adjusted death rate, males	6.23 (0.26)	6.20 (0.16)	6.26 (0.28)	6.63 (0.44)	6.46 (0.19)	0.235
	Age-adjusted death rate, females	3.28 (0.14)	3.15 (0.13)	3.15 (0.12)	3.24 (0.18)	3.18 (0.16)	-0.152
	Death rate of people ≥ 65 years old	34.29 (1.30)	34.34 (1.30)	34.88 (1.41)	35.04 (1.29)	35.51 (0.86)	0.337*

*p<0.05; **p<0.01.

Table 2.8 shows the mean and rank of each mortality and LTC indicator of the nine Japanese regions in 1995, 2000, and 2005. During this period, variations in mortality indictors in different regions were identified. A stable, higher age-adjusted death rate for both males and females was observed in Tohoku, whereas stable, lower age-adjusted death rates were observed for both males and females in Okinawa and Chubu from 1995 to 2005. The death rates of people age ≥ 65 years were consistently high in Shikoku and Chugoku, while they were low in Okinawa, Hokkaido, and Kanto from 2000–2005. In Kyushu and Chugoku, the rates of certification for LTC need remained stably high, while in Kanto, Chubu and Tohoku, the rates remained low from 2000–2005.

The mean and rank of each SES indicator of the nine Japanese regions in 1995, 2000, and 2005 are shown in Table 2.9. Okinawa, Hokkaido, and Tohoku had consistently lower higher education enrollment rates; conversely, Kansai and Chubu had stably higher enrollment rates in higher education from 1995–2005. In Okinawa, Kyushu, and Tohoku, the per capita income remained consistently low, while Kanto, Chubu, and Kansai had higher per capita income levels from 1995– 2005. Hokkaido had the most stable lower total employment rate among the nine regions; in contrast, Kanto and Chubu had higher total employment rates during this period.

In general, the variations in the 47 prefectures and 9 regions showed higher SES levels and lower mortality and LTC application rates, like in the Kanto and Chubu regions; and lower SES levels and higher mortality and LTC application rates, as in Tohoku. However, other regions showed miscellaneous patterns for these two parameters; for example, Okinawa had a lower SES level and lower mortality and LTC application rates.

Table 2.8: Mortality and LTC indicators of 9 regions in Japan.

Indicators	Regions	1995		2000		2005	
		Mean	Rank	Mean	Rank	Mean	Rank
Age-adjusted death rate, males	Hokkaido	7.08	3	6.37	4	6.13	8
	Tohoku	7.36	8	6.68	9	6.43	9
	Kanto	7.11	4	6.27	2	5.90	3
	Chubu	6.79	1	6.04	1	5.71	1
	Kansai	7.42	9	6.39	5	5.91	4
	Chugoku	7.19	6	6.43	5	6.04	6
	Shikoku	7.18	5	6.46	8	6.12	7
	Kyushu	7.31	7	6.45	7	6.00	5
	Okinawa	6.79	2	6.33	3	5.77	2
Age-adjusted death rate, females	Hokkaido	3.73	5	3.17	5	2.96	5
	Tohoku	3.80	7	3.28	8	3.05	8
	Kanto	3.89	8	3.31	9	3.08	9
	Chubu	3.67	3	3.09	2	2.87	2
	Kansai	4.07	9	3.27	6	3.03	7
	Chugoku	3.65	2	3.11	3	2.83	1
	Shikoku	3.71	4	3.27	7	3.00	6
	Kyushu	3.76	6	3.17	4	2.91	4
	Okinawa	3.23	1	2.88	1	2.88	3
Death rate of people ≥ 65 years old	Hokkaido	—	—	32.50	2	33.56	2
	Tohoku	—	—	34.90	6	36.38	7
	Kanto	—	—	34.17	3	34.33	3
	Chubu	—	—	34.44	4	35.21	5
	Kansai	—	—	35.23	7	35.17	4
	Chugoku	—	—	35.75	8	36.47	8
	Shikoku	—	—	36.07	9	37.21	9
	Kyushu	—	—	34.77	5	35.76	6
	Okinawa	—	—	32.38	9	31.78	1
Rate of certification for LTC need	Hokkaido	—	—	11.48	5	16.45	4
	Tohoku	—	—	11.08	3	16.22	3
	Kanto	—	—	9.23	1	13.99	1
	Chubu	—	—	10.37	2	15.15	2
	Kansai	—	—	11.16	4	17.27	5
	Chugoku	—	—	12.91	7	18.14	8
	Shikoku	—	—	12.53	6	18.57	9
	Kyushu	—	—	13.57	8	18.13	7
	Okinawa	—	—	16.23	9	17.32	6

Table 2.9: SES indicators of 9 regions in Japan.

Indicators	Regions	1995		2000		2005	
		Mean	Rank	Mean	Rank	Mean	Rank
Enrollment rate in higher education	Hokkaido	28.50	7	35.40	7	36.40	8
	Tohoku	27.87	8	34.22	8	37.60	7
	Kanto	35.39	5	45.53	4	48.64	3
	Chubu	41.20	2	47.37	2	49.41	2
	Kansai	42.63	1	50.94	1	52.31	1
	Chugoku	39.36	4	44.76	5	45.58	5
	Shikoku	40.10	3	46.23	3	46.63	4
	Kyushu	35.16	6	38.44	6	39.81	6
	Okinawa	22.90	9	31.10	9	31.10	9
Prefectural per capita income	Hokkaido	2775.00	5	2714.00	5	2507.00	5
	Tohoku	2629.67	7	2623.00	7	2430.33	7
	Kanto	3371.29	1	3326.71	1	3196.14	1
	Chubu	3053.67	2	3102.56	2	2979.67	2
	Kansai	3023.71	3	2978.43	3	2905.29	3
	Chugoku	2776.60	4	2778.40	4	2657.40	4
	Shikoku	2637.50	6	2678.00	6	2473.25	6
	Kyushu	2487.43	8	2501.57	8	2375.43	8
	Okinawa	2136.00	9	2106.00	9	2040.00	9
Total employment rate	Hokkaido	61.60	7	59.70	7	58.70	9
	Tohoku	63.68	4	62.05	3	60.92	3
	Kanto	65.10	2	63.41	2	62.73	2
	Chubu	66.51	1	64.51	1	63.68	1
	Kansai	61.87	6	60.00	5	59.59	7
	Chugoku	63.92	3	61.64	4	60.78	4
	Shikoku	62.15	5	59.98	6	59.25	8
	Kyushu	61.23	8	59.61	9	59.60	5
	Okinawa	61.20	9	59.70	7	60.10	6

2.3.2 Correlation Analysis Results

Correlation coefficients between mortality, LTC indicators, and enrollment rates in higher education are shown in Table 2.4. In 1995, education level showed no significant relationship with mortality. In contrast, in 2000, education level was statistically significantly and strongly (r = -0.40) associated with age-adjusted death rate for males. In 2005, the enrollment rate in higher education was also negatively and strongly associated with age-adjusted death rate for males (r = -0.50); moreover, the coefficient in 2005 was larger than it was in 2000. Nevertheless, education level did not show a close or significant correlation with age-adjusted death rate in females over time.

Regarding prefectural income level (Table 2.5), in 1995, no close correlations were observed between per capita income and any mortality indicator. In 2000, per capita income was negatively and strongly associated with age-adjusted death rate for males (r = -0.39) and rate of certification for LTC need (r = -0.50). In 2005, per capita income had significant and strong relationships with age-adjusted death rate for males, and the coefficient was larger (r = -0.43) than it was in 2000. Moreover, significant correlations also appeared between per capita income and death rates of individuals age ≥ 65 years (r = -0.35) and rates of certification for LTC need (r = -0.41). Nevertheless, no association between per capita income and age-adjusted death rate was observed for females during this period.

Correlation coefficients between each mortality indicator and total employment rate are shown in Table 2.6. In 1995, a strong, significant correlation between total employment rate and age-adjusted death rate for males (r = -0.40) was identified. In 2000, total employment rate was found to be strongly and significantly associated with age-adjusted death rate for males (r = -0.37) and rate of certification for LTC need (r = -0.60). In 2005, total employment rate had significantly negative and strong associations with age-adjusted death rate for males (r = -0.35) and rate of certification for LTC need (r = -0.69). For women, total employment rate was not associated with age-adjusted death rate over time.

A stronger positive correlation between age-adjusted death rate for males and LTC application rate was identified in 2000 (r = 0.33). In 2005, there was a stronger positive correlation between the death rate of people age ≥ 65 years and rate of certification for LTC need (r = 0.34) (Table 2.7).

2.3.3 Regression Analysis Results

Table 2.10 shows the final results of the simple regression analysis conducted on the age-adjusted death rate for males, including independent socioeconomic indicators and LTC, which have shown statistically significant associations in the correlation analysis. There were significant inverse associations between all the socioeconomic factors (enrollment in higher education, higher per capita income, and total employment rate) and the age-adjusted death rate for males. As shown in Table 2.10, the enrollment in higher education in 2005 was the variable that most strongly influenced the geographical distribution of age-adjusted death rate for males, which accounted for 24% of the variance in these rates. From 1995 to 2005, the effects of enrollment in higher education and per capita income on the variations in age-adjusted death rates for males increased. However, in the same period, the effect of total employment rate decreased. As the LTC application rate increased, the age-adjusted death rate for males was expected to increase, and 10% of the variance could be accounted for by the LTC application rate in 2000.

Table 2.11 shows the linear regression model of death rate of people age ≥ 65 years in 2005. As the per capita income increased, the death rate of people age ≥ 65 years was expected to decrease; moreover, 10% of the variance of death rate of individuals ≥ 65 years could be accounted for by the per capita income in 2005. Moreover, as the LTC application rate increased, the death rate of people age ≥ 65 years was expected to increase.

Table 2.12 shows the final regression models on the rate of certification for LTC need in 2000 and 2005, respectively. There were inverse associations between two socioeconomic factors (higher per capita income, and total employment rate) and the rates of certification for LTC need. Total employment rate in 2005 was the most influential factor on geographic distribution, with a R^2 of 0.47. Per capita income in 2000 showed a larger influence on the geographic distribution of rate of certification for LTC need than it did in 2005 (R^2 of 0.34 vs. R^2 of 0.15).

Table 2.10: Results of univariate linear regression analysis: age-adjusted death rate for males associated with SES and LTC.

Year	Variables	B	SE	Exp (B)	*p* -value	95% CI		Adjusted R^2
						lower	upper	
1995	Total employment rate	-0.071	0.024	-0.398	0.006	-0.120	-0.022	0.140
2000	Enrollment rate in higher education	-0.019	0.007	-0.399	0.005	-0.032	-0.006	0.141
	Per capita income	0.000	0.000	-0.385	0.008	-0.001	0.000	0.129
	Total employment rate	-0.052	0.020	-0.365	0.012	-0.092	-0.012	0.114
	LTC application rate	0.059	0.025	0.334	0.022	0.009	0.110	0.092
2005	Enrollment rate in higher education	-0.025	0.006	-0.502	0.000	-0.038	-0.012	0.236
	Per capita income	0.000	0.000	-0.431	0.003	-0.001	0.000	0.168
	Total employment rate	-0.057	0.023	-0.345	0.018	-0.103	-0.010	0.099

Table 2.11: Results of univariate linear regression analysis: death rate of people ≥ 65 years associated with SES and LTC.

Year	Variables	B	SE	Exp (B)	*p* -value	95% CI		Adjusted R^2
						lower	upper	
2005	Per capita income	-0.001	0.001	-0.352	0.015	-0.002	0.000	0.104
	LTC application rate	0.291	0.121	0.337	0.021	0.047	0.535	0.094

Table 2.12: Results of univariate linear regression analysis: rate of application for LTC need associated with SES.

Year	Variables	B	SE	Exp (B)	*p* -value	95% CI		Adjusted R^2
						lower	upper	
2000	Per capita income	-0.003	0.001	-0.595	0.000	-0.004	-0.002	0.340
	Total employment rate	-0.480	0.095	-0.602	0.000	-0.672	-0.289	0.348
2005	Per capita income	-0.002	0.001	-0.407	0.005	-0.003	-0.001	0.147
	Total employment rate	-0.660	0.103	-0.691	0.000	-0.867	-0.452	0.466

2.4 Discussions

We applied a time trend analysis between 1995 and 2005 using annual prefectural data to show SES, LTC, and mortality variations among the 47 prefectures in Japan. The study demonstrated that prefectural mortality was associated with SES factors such as education, income, employment, and LTC application rate, and gender differences between these associations were also observed during this time period.

2.4.1 SES, LTC, and Mortality Variations in Japan

Possible contributors to the improved health of the Japanese population have been noted in previous studies. An egalitarian social system and culture appear to contribute substantially through compulsory education, universal health insurance coverage, public health services, income-adjusted policy, and strong social relationships to further improve the health of the population[11-13]. The egalitarian society, however, may be changing. The economic recession that followed the collapse of the bubble economy in the early 1990s and the subsequent policies on economics, taxation, and social security might have contributed to increased socioeconomic inequalities. Following the crumbling of the lifetime employment system in Japanese companies, the increase in unstable employment, and the increase in social security costs might have also accelerated worries about increasing socioeconomic inequalities[14-16].

SES has been shown, by cross-sectional, longitudinal, and ecological studies, to be a primary determinant of health[17-19]. The degree of socioeconomic inequalities in a society is closely linked to the health of the population. The results obtained by correlation analysis and regression analysis in this study revealed the explanatory socioeconomic factors for mortality and LTC indicators. In 1995, only the total employment displayed correlation with age-adjusted death rate for males; in 2000 and 2005, all three SES indicators were found to be inversely associated with age-adjusted death rate for males. The Pearson’s coefficients showed complicated associations between SES and mortality over time; for example, the correlation between education and income and age-adjusted death rate for males became stronger from 1995–2005, while the association between total employment and age-adjusted death rate for males weakened.

2.4.2 Gender Differences in SES-Mortality Associations

With respect to gender differences in the correlation analysis, three SES indicators significantly associated with age-adjusted death rate for males (income, education, and employment) did not show significant differences for females during the period from 1995–2005. Although indicators such as death rate of people ≥ 65 years and rate of application for LTC were not differ by gender, the results suggested that prefectural SES influenced health level more strongly in men than in women. The finding that male mortality was predicted by SES more strongly than female mortality is supported by previous studies[20, 21]. There are several plausible explanations for this tendency. Firstly, males were more sensitive to socioeconomic status than females[22]. Secondly, it could be related to lifestyle factors such as smoking, unhealthy diet, and alcohol consumption. Lifestyle factors are important pathways through which SES adversely influences health[23, 24]. In Japan, the percentage of individuals with unhealthy lifestyle, such as smoking and alcohol consumption, is strikingly lower in females than in males[25]. The relatively healthy lifestyle in women may weak the association between SES and age-adjusted death rate for females. Thirdly, complicated associations existed between mortality and the different SES indicators. Fukuda et al. (2004) reported that male mortality is more strongly correlated with income- and education-related indictors than is female mortality; in contrast, female mortality showed a stronger correlation with living space-related indicators than did male mortality, due to a longer time spent at home by females[26]. Lastly, combined with some individual-level studies, men are more likely to die earlier than women are, and mortality may be strongly influenced by one's sense of well-being in men, while it is more likely caused by actual physical and mental health status in women[27, 28]. All the above factors may lead to the gender differences in the direct effect of SES on mortality.

2.4.3 SES Effect on Mortality and LTC of the Elderly

The present study revealed that the association between death rate of people age ≥ 65 years and prefectural per capita income became stronger and significant in 2005. Two other SES indicators, education and employment, are associated in all age groups, while the death rate of people age ≥ 65 years was an indicator for this older population. Thus, this gap may explain the insignificant associations. Nevertheless, the SES effect on mortality of the elderly should be more closely examined, particularly in recent years. Previous studies on health inequality have primarily focused on the relationship between SES and premature mortality, and the association tended to be stronger in the younger population[29-31]. The weak relationship between SES and mortality in the elderly population could be primarily explained by selective survivor bias, in which vulnerable people are likely to die before becoming elderly; thus, elderly people are less vulnerable and represent healthier survivors[32, 33]. However, the relationship is not always weaker in the elderly population, and inconsistent but substantial evidence exists regarding a relationship between SES and mortality or morbidity in the elderly[34-36].

Rate of application for LTC need was chosen as the indicator of prefectural LTC level and disability status in this study and was found to be significantly associated with mortality. In addition, the rate of application for LTC need of older people had associations with employment and income at the prefectural level, but it was not associated with education level in either 2000 or 2005. This suggests that in Japan, employment and income of older people are more important predictors for decreasing the LTC need compared to education level. There are a few plausible explanations for this tendency. One is the indicator for education that was used — enrollment rate in higher education — which has a weak effect on application for LTC services for the elderly. Another explanation addressed the indirect effect of education on LTC application, because educational attainment as a primary indicator of SES would shape the ability to get a good job, earn more money, and become informed about healthy lifestyles. Expected years of life without care needs were calculated and prefectural distributions were reported in previous studies[37, 38]; however, the association between SES and LTC need for the Japanese elderly remains unclear and warrants further examination. In the LTC field, a consensus exists that disability among the elderly is the primary factor driving the demand for LTC services, and there appears to be a consistent inverse relationship between SES and disability[39, 40].

2.4.4 Study Limitations

The possible geographic differences among areas within a country are of great interest to public health and health policy as they show the potential for prevention that still exists. The finding of differences in health within a country, for example, should suggest consideration of what factors affecting such variations can be modified[41]. The national health plan in Japan, "Health Japan 21," accompanied by local actions plans, aims to prolong HALE and eliminate health inequality at both the national and local levels through disease prevention and health promotion[42]. Thus, studying health disparities by different SES and their trends over time can play an important part in future health policy. Findings of this study were obtained with reliable mortality, LTC, and SES data at the prefectural level. Nonetheless, the results should be viewed with caution.

One limitation is the chosen indicators in this study. Because the selection of both mortality and SES variables may produce different result patterns, more specific indicators should be selected for analysis, such as cause-specific death rate, which could help elucidate more detailed information of mortality. Prefectural indicators representing SES have not yet been established in Japan, unlike in some countries where indicators such as deprivation indices have been applied[43]. In this study, the SES in a prefecture consists of various aspects (income, education, and employment) that are correlated with each other and influence mortality and LTC in complicated manners. Thus, univariate regression analysis was applied only considering the multicollineartiy effects. As a result, the development of prefecture-based socioeconomic indicators is an urgent challenge for the study of health inequalities in Japan.

The second limitation is that the observation period is too short to conclude that health inequalities increased since 1995. Health inequalities should be continuously monitored.

Thirdly, for natural phenomena, ecological studies have methodological limitations, including confounding factors and fallacy[44]. However, the objective is neither to draw conclusions about the factors determining the health of people, nor to establish causal relationships of population health with its related factors, but rather to identify the socioeconomic factors involved in the differences in mortality distribution at the prefectural level, particularly in the long term.

2.5 Conclusions

In conclusion, the factors that explain the mortality, LTC, and SES variations in Japan demonstrated that prefectures that had higher socioeconomic levels and lower LTC application rates had lower death rates. Future studies with individual-level analyses should be conducted to provide more conclusive evidence.

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Chapter 3

Healthy Life Expectancy in Relation to Socioeconomic Status and Physical Health among Japanese Elderly

3.1 Introduction

Health is a state of complete physical, mental and social well-being, not merely the absence of disease or infirmity[1]; thus, three health-related dimensions — namely, physical health, mental health and social health — can be hypothesized to be associated with life expectancy. In recent years, the concept of healthy life expectancy (HALE) has been increasingly used to measure “the equivalent years in full health that a person can expect to live on the current mortality rates and prevalence distribution of health states in the population.”[2] Measurement of a series of indicators, such as self-rated health (SRH), disability or activity limitation, and the consequences of disease, has shifted the focus from quantity of life to quality of life[3]. The population is aging worldwide, and the health issues of the elderly are becoming of greater concern, especially the HALE of the elderly.

SRH has been used to measure HALE, mainly because it is easy to measure (it only requires a single question) and data exists for many populations. Moreover, SRH was most commonly used to obtain a comprehensive view of the respondent’s overall well-being with regard to non-fatal health outcome, and it is known to be a strong predictor of mortality in longitudinal studies[4]. Using data from the World Value Survey, Carlson[5, 6] found that, at the national level, SRH correlated well with mortality from all causes. Similarly, a study in 13 countries of Central and Eastern Europe and the former Soviet Union found a strong ecological correlation (r = -0.73) between the age- and sex-standardized prevalence of SRH, and life expectancy[7]. At the individual level, although a range of research has shown that SRH correlated well with mortality, the interpretation of findings on SRH is not always straightforward, as it combines biological, psychological, psychosocial and other influences[8].

In 2001, the World Health Organization (WHO) published the International Classification of Functioning, Disability and Health (ICF), which consists of two parts: Functioning and Disability, and Contextual Factors[9]. The rapid and unprecedented increase in human life expectancy was associated with profound changes in the prevailing patterns of disease and disability. Disability is typically assessed by means of self-reported measures that evaluate the ability to perform a set of tasks needed to maintain one’s lifestyle in order to live independently[10]. Much evidence has suggested that people in poorer physical health are more likely to die[11], and functional limitation is most common among the elderly. Becoming disabled is not only associated with substantial personal costs by reducing employment and income, but also increasing social cost, like the needs of long-term care and medical expenditures. Therefore, it is necessary to explore the effect of physical disability on mortality among the elderly.

The other aspect of ICF, Contextual Factors, includes environmental and personal factors, such as gender, age and income, which are independent of health condition, but may influence a person's functionality. Previously, environmental factors including social and economic factors were thought to influence health; now, reports link individual socioeconomic status (SES) — measured by educational level, occupational class and income — to mortality, morbidity, and access to health care services[12]. However, the importance of each component may differ between and within countries and cultures[13].

Japan is the most rapidly aging society in the world, and the Japanese people have the longest overall life expectancy and HALE at birth. A great deal of attention has been paid to factors associated with the longevity of people in Japan. The rapid reduction in mortality rate was attributable to education policies and the narrowing gap in income after the Second World War[14]. Although Japan is typically a more egalitarian society compared to other developed nations, substantial health disparities across regions and occupations have been documented during the past two decades[15, 16]. The results of a related ecological study from Fukuda et al.[17] indicated the health status of older people substantially declined because of disadvantageous SES. However, the structural causal relationship between individual SES and HALE among the Japanese elderly is not well-understood.

Examining the effects of individual risk factors (e.g. chronic illness and physical disability) for HALE is not a new concept; however, their combined effect with SES on HALE is less well-defined. In addition, current studies are largely based on data from Western nations, and the validity of prior observations needs to be further evaluated with regard to the influence of SES. The aim of this study was to examine the structural causal relationships between SES, physical health and HALE, as well as to further clarify how the effects of SES on HALE interact with gender, age and geographic location among the elderly in Japan.

3.2 Data and Methods

3.2.1 Study Design and Subjects

The data in this study was obtained through the project, “A long term follow-up study of comprehensive health promotion and disease prevention programs for the elderly supported by public health centers (1998–2000),” supported by a grant-in-aid for comprehensive research on regional public health from the Ministry of Health, Labour and Welfare of Japan.

The study area included 16 municipalities of 10 prefectures across Japan, and was organized through collaboration with local government and public health centers (Figure 3.1). In order to determine whether geographical positioning was a significant factor, the target regions were classified into city, town and village. According to the administrative divisions of Japan, the status of a municipality, if it is a village, town or city, is decided by the prefectural government. To be recognized as a city, a municipality must have a population of 50,000 or more, and must meet various other requirements as well. Towns must also meet certain conditions prescribed by prefectural ordinances. Generally, a village or town can be promoted to a city when its population increases above fifty thousand, and a city can (but need not) be demoted to a town or village when its population decreases below fifty thousand. In terms of regional classification, two cities, ten towns and four villages were in this study.

From July 31, 1998 to July 20, 1999, a questionnaire survey was distributed in 16 municipalities to all elderly individuals (aged ≥ 60 years) who lived at home. Of 30,521 eligible elderly individuals, 23,826 elderly (response rate of 78.1%) gave informed consent to participate in the study and responded to the self-rated questionnaire by mail and interview with the help of local public nurses. We followed these participants until June 30, 2000, and ultimately collected data on their vital status through the municipalities’ registry. Because the baseline survey time differed with each municipality, the average follow-up time was 512 days, ranging from 326 to 700 days.

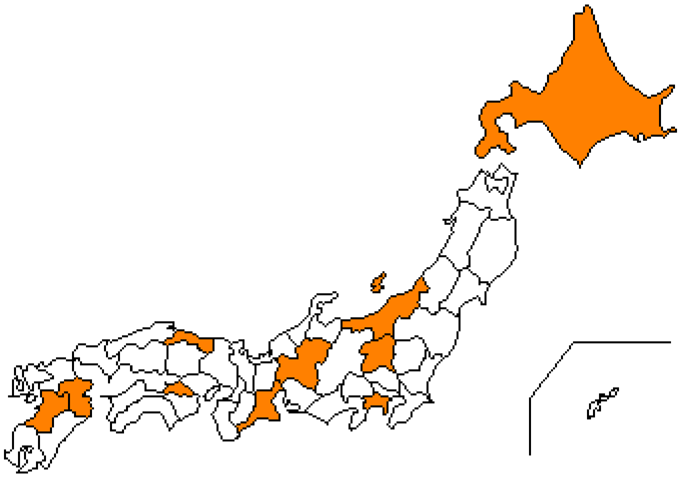

Figure 3.1: The study area included 16 municipalities of 10 prefectures across Japan.

Respondents younger than 65 years and older than 85 years were excluded from analyses because, not only is the chronological age of 65 years the accepted definition of “elderly” in Japan, but also because these age groups have an increased and indispensable deviation in their measurement variables. In addition, those with missing gender-data were also excluded, bringing participants to 15,254 individuals. In this study, we defined ‘young-old’ and ‘old-old’ as aged between 65 to 74 years and between 75 to 84 years, respectively (Table 3.1).

Table 3.1: Study subjects by gender, age and geographic location.

			Village (n = 1,402)	Town (n = 9,825)	City (n = 4,027)	Total (n = 15,254)
Men (n = 6,643)	Young-old	n	442	3,081	1,165	4,688
		%	9.4	65.7	24.9	100
	Old-old	n	184	1,280	491	1,955
		%	9.4	65.5	25.1	100
Women (n = 8,611)	Young-old	n	500	3,687	1,687	5,874
		%	8.5	62.8	28.7	100
	Old-old	n	276	1,777	684	2,737
		%	10.1	64.9	25	100

3.2.2 Data Collection

HALE

In this study, HALE was explained by two indicators: self-rated health (SRH) and vital status. A single assessment question of "How would you rate your general health: very good, good, fair or poor?" was used to measure the SRH of the participants. This information was collected from the questionnaire in the baseline survey.

Based on the vital status (alive or deceased) obtained from the municipal residents' registry, survival time was calculated by the number of days alive from the baseline survey period to June 30, 2000.

Physical Health

Two variables of physical health were used in the questionnaire survey: "chronic illness" and "physical disability".

Data on chronic illness were collected by measuring the "degree of pain" and "comorbidity". The degree of pain was determined by instructing the individuals to describe the amount and area of pain (e.g., waist, arthritis, ankle, foot, head, shoulder, or other) they were currently experiencing. For the presence of each pain, it was rated on a 2-point scale: 0 = no pain and 1 = pain. The overall sum of scores ranged from 0 to 7 with a higher score indicating a high pain risk. In order to have fewer groups in the Cox regression, it was collapsed into three groups: "1 = 0 point," "2 = 1 point" and "3 = higher than 1 point." The prevalence of comorbidity was determined by instructing the individuals to answer the question: "Do you have any illnesses under treatment, such as hypertension, cerebrovascular disease, diabetes mellitus, cardiovascular disease, hepatic disease or other diseases?" For the presence of each illness, one point was given, and the overall un-weighted sum of scores ranged from 0 to 5, with a higher score indicating more diseases. Then, it was collapsed into three level groups: "1 = 0 point," "2 = 1 point" and "3 = higher than1 point".

Two indicators were used to figure out the respondent's level of physical disability: instrumental activities of daily living (IADL), and bedridden status. The IADL score was measured via five questions related to instrumental activity[18]: "Can you buy groceries by yourself?" "Can you cook day-to-day meals by yourself?" "Can you conduct banking transactions by yourself?" "Can you manage your insurance and pensions by yourself?" and "Can you read newspapers and books?" Individuals obtained one point if they could not perform these functions, and overall scores ranged from 0 to 5, with a higher score indicating a greater level of physical disability. Cronbach's alpha coefficient for the reliability of these five items was 0.83, indicating they had internal consistency for this investigation. The total score was collapsed into three groups: "1= 0 point," "2 = 1 point" and "3 = higher than 1 point." The bedridden status was measured by asking the question: "Can you toile down and get up from bed, by yourself, in the daytime?" It was scored using a four-point Likert Scale anchored at the ends, with 1 = "able to" to 4 = "unable to". Then, it was also collapsed into three level groups according to degree, with a higher score indicating a worse status.

Socio-demographic Variables

The demographic information of these subjects, including gender, age and geographic location, were obtained. Annual income as the indicator of SES was evaluated from the answer to the question, "How much is your annual income?" and it was categorized as an 11-level ordinal variable from "less than 1 million Japanese yen" to "more than 10 million yen." In Cox regression analysis, it was collapsed into three groups: "1 = 0-1 million yen," "2 = 1-3 million yen," and "3 = higher than 3 million yen."

3.2.3 Data Analysis

Firstly, the missing data in variables were dealt with by mean substitution that replaced the missing value with the mean of the variable. Simple frequency analysis was performed to examine personal characteristics of all subjects. The significance of differences between the subgroups (e.g. gender, age and geographic location) were tested by cross-tabulation and two-tailed chi-squared test. Estimated cumulative survival rates were calculated by the Kaplan-Meier method, and a log-rank test was used for testing the association between survival and potential risk variables (including the physical health variables and socio-demographic variables). All variables were then entered into the Cox regression model. Hazard ratios (HR) with 95% confidence intervals (CI) were calculated to assess the association between predictor variables and survival. A p-value < 0.05 was considered statistically significant. These analyses were carried out using SPSS 19.0 for Windows.

To assess the relative impact of SES and physical health on SRH, structural equation modeling (SEM) was applied for analysis using AMOS 17.0 for Windows. In SEM analysis, two observed variables (annual income and SRH) and two latent variables (physical disability and chronic illness) were used. In the hypothetical model (Figure 3.2), annual income as an exogenous variable was predictive of physical disability, chronic illness and SRH, while physical disability and chronic illness may be predictive of SRH. The maximum likelihood (ML) estimation method was used to estimate the parameters in the model. Tests of significance of the estimated parameters (path coefficient) were set at a 0.05 level for two-tailed tests. The chi-squared test was used to evaluate the hypothesized model and its improvement from the independence model. To address the limitations of the chi-squared test, other alternative model fit indices such as the Root Mean Square Error of Approximation (RMSEA), the Normed Fit Index (NFI), and Comparative Fit Index (CFI) were used to assess the model fit. Modes with NFI and CFI close to 1 are considered to indicate a good fit. An RMSEA value of less than 0.05 is indicative of the model being a reasonable approximation of the data[19]. In addition, the direct, indirect and total effects of each latent variable on the SRH were determined by subject subgroups. Group comparison analysis was done to examine the differences/similarities in the measurement and structural relationship.

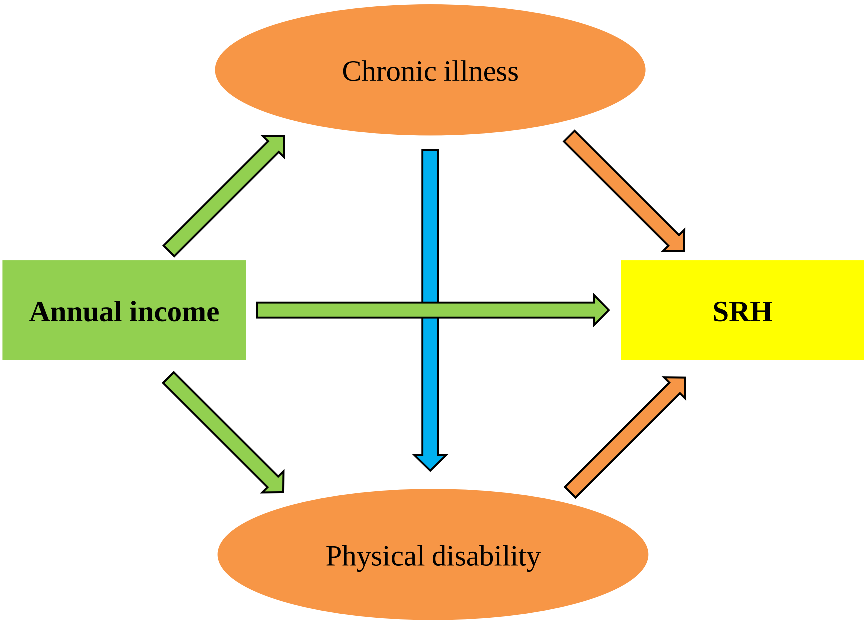

Figure 3.2: Hypothetical model — structural relationships between annual income, physical disability, chronic illness and SRH.

3.3 Results

3.3.1 Frequency Distribution for Observed Variables

HALE Characteristics of Respondents

During the follow-up period, 307 subjects passed away, with the cause of death being cancer for 29.0% of the deceased, heart disease for 19.9%, infectious diseases for 13.4%, cerebrovascular disease for 10.8%, and "other reasons" for the remaining 21.2%. Figure 3.3 shows the distribution of the cause of death by age and gender. The number of elderly people who died of cancer, heart disease and infectious disease were higher in young-old elderly men than in other groups, while the number of people who died of cerebrovascular disease was higher among young-old women than among other groups. Regarding SRH (Table 3.2), over 70% of the respondents answered that they were well in the baseline survey, with 9.2% answering "very good" and 63.6% answering "good". The remaining 30% reported being in "fair" (18.5%) or "poor" (8.6%) condition.

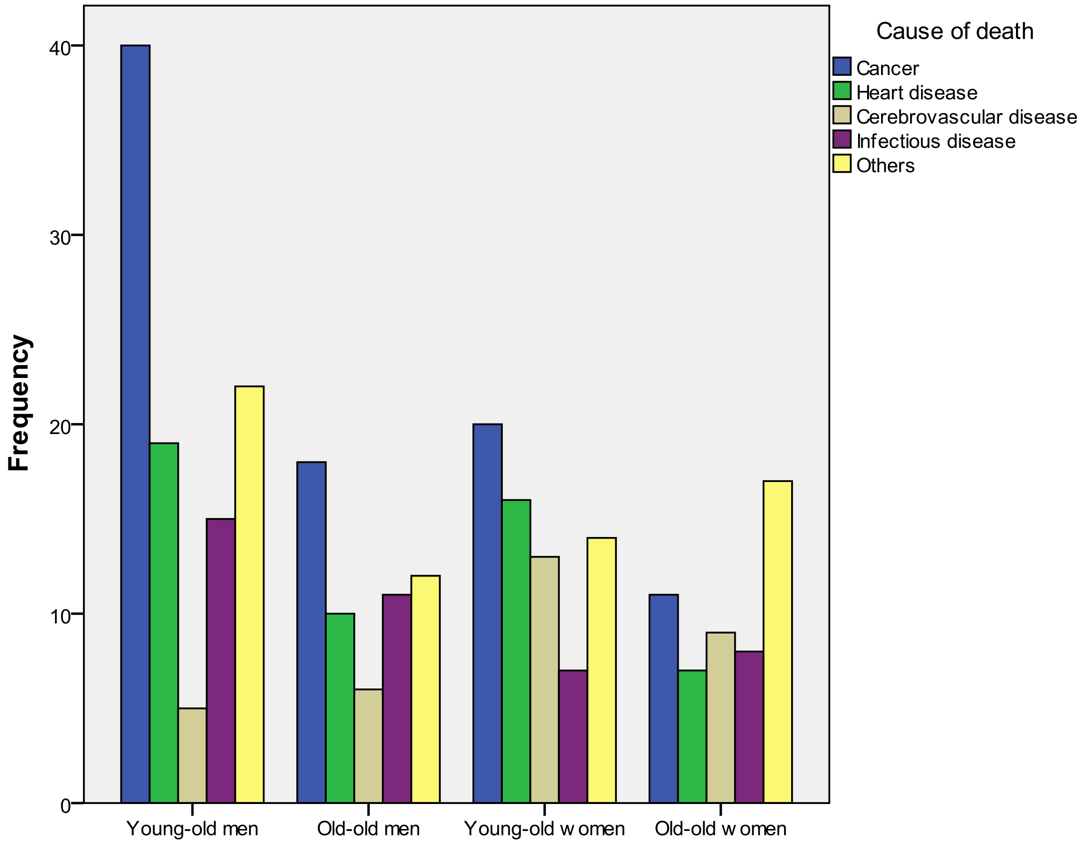

Figure 3.3: Cause of death by gender and age.

Table 3.2: HALE characteristics of respondents: vital status and SRH.

Variables	Indicators	Total (n = 15,254)	
		n	%
Vital status	alive	14,947	98.0
	deceased	307	2.0
SRH	poor	1,312	8.6
	fair	2,829	18.5
	good	9,708	63.6
	very good	1,405	9.2

Physical Health Characteristics of Respondents

Table 3.3 shows the physical health characteristics of all subjects. In measurement of the degree of pain, 47.6% scored more than 1 point, while subjects who reported no pain on any part of their body only accounted for 22.9%. Based on the pre-calculation result, over 40% reported waist pain and approximately 30% reported they had arthritis pain. Over 60% of the subjects reported they had at least one disease, and 30.5% of them had hypertension. Most of the subjects had a low score of IADL disability and bedridden status, indicating they could take care of themselves independently.

Socio-demographic Characteristics of Respondents

Data was available for a total of 15,254 subjects (Table 3.1), of whom 6,643 were males and 8,611 were females. The mean age was 71.87 (SD = 4.88) in men, 72.16 (SD = 4.97) in women, and 72.04 (SD = 4.93) in both genders combined. There were 10,562 subjects in the young-old age group, and 4,692 subjects in the old-old age group. As shown in Table 3.1, 64.4% of the subjects lived in towns, 9.19% lived in villages, and 26.4% lived in cities, respectively.

Table 3.4 shows the distribution of annual income: most participants reported their income to be between 1 million and 3 million yen, followed by lower than 1 million yen (25.5%) and higher than 3 million yen (20.0%).

Table 3.3: Physical health characteristics of respondents.

Variables	Indicators	Category- before	Total (n = 15,254)		Category- after	Total (n = 15,254)	
			n	%		n	%
Degree of pain	waist	yes	6,432	42.2			
		no	8,822	57.8			
	arthritis	yes	4,365	28.6	0 point	3,495	22.9
		no	10,889	71.4			
	ankle	yes	1,930	12.7			
		no	13,324	87.3			
	foot	yes	4,078	26.7			
		no	11,173	73.2	1 point	4,496	29.5
		missing	3	0.0			
	head	yes	1,333	8.7			
		no	13,921	91.3			
	shoulder	yes	3,965	26.0			
		no	11,289	74.0	higher than 1 point	7,263	47.6
	other parts	yes	766	5.0			
		no	12,818	84.0			
		missing	1,670	10.9			
Comorbidity	hypertension	yes	4,656	30.5			
		no	10,597	69.5	0 point	5,853	38.4
		missing	1	0.0			
	cerebrovascular disease	yes	685	4.5			
		no	14,569	95.5			
	diabetes mellitus	yes	1,091	7.2	1 point	6,946	45.5
		no	14,163	92.8			
	cardiovascular disease	yes	1,872	12.3			
		no	13,382	87.7			
	hepatic disease	yes	606	4.0			
		no	14,648	96.0	higher than 1 point	2,455	16.1
	other diseases	yes	3,497	22.9			
		no	11,757	77.1			
IADL disability	shopping	unable to	1,049	6.9			
		able to	12,609	82.7	0 point	9,633	63.2
		missing	1,596	10.5			
	cooking	unable to	1,460	9.6			
		able to	11,943	78.3			
		missing	1,851	12.1			
	conducting banking transactions	unable to	1,211	7.9			
		able to	12,178	79.8	1 point	3,956	25.9
		missing	1,865	12.2			
	managing insurance and pension	unable to	1,795	11.8			
		able to	11,514	75.5			
		missing	1,945	12.8			
	reading	unable to	1,605	10.5	higher than 1 point	1,665	10.9
		able to	11,813	77.4			
		missing	1,836	12.0			
Bedridden status	Getting up and lying down in bed in the day time	able to (all the time)	11,066	72.5	1 point	12,749	83.6
		able to (for a long time)	1,759	11.5	2 point	1,759	11.5
		able to (for a short time)	406	2.7			
		unable to	340	2.2	3 point	746	4.9
		missiing	1,683	11.0			

Table 3.4: Socioeconomic characteristics of respondents: annual income.

Variables	Category-before	Total (n = 15,254)		Category-after	Total (n = 15,254)	
		n	%		n	%
Annual income (yen)	0 million	386	2.5	0-1 million	3,883	25.5
	0-1 million	3,497	22.9			
	1-2 million	3,226	21.1			
	2-3 million	2,289	15	1-3 million	8,318	54.5
	3-4 million	1,510	9.9			
	4-5 million	661	4.3			
	5-7 million	480	3.1			
	6-8 million	137	0.9	higher than 3 million	3,053	20.0
	8-9 million	92	0.6			
	9-10 million	56	0.4			
	higher than 10 million	117	0.8			
	missing	2,803	18.4			

3.3.2 Prevalence of Observed Variables in Different Subgroups

Table 3.5 shows the distribution of seven observed variables by gender and age. Compared to elderly women, more elderly men passed away during the follow-up period. Surprisingly, more elderly men rated their health as "very good". Regarding the physical health indicators, the elderly women reported more pain, more IADL disability, and a more serious bedridden status compared to the men. The distributions of comorbidity between each subgroup were almost the same. The gender differences in vital status, SRH, degree of pain, IADL disability and annual income were statistically significant ($p < 0.001$). For the elderly men, the age difference in IADL disability, bedridden status and annul income was statistically significant, whereas for women, the age differences in all variables were statistically significant except in degree of pain ($p = 0.88$).

Table 3.6 shows the distribution of seven observed variables by geographic areas. Most of the subjects who passed away during the follow-up period lived in towns. The subjects living in cities were more likely to have rated their health as "good" than other groups. In addition, subjects with no pain, no disease and no disability were more likely to have been living in a city than in a town or a village. There were also more subjects who earned higher than 3 million yen living in cities. All differences between areas and all observed variables were statistically significant ($p < 0.001$ and $p < 0.01$).

Table 3.5: Distribution of observed variables by gender and age.

	Elderly men					Elderly women					*p*-value
	Young-old (n = 4,688)		Old-old (n = 1,955)		*p*-value	Young-old (n = 5,874)		Old-old (n = 2,737)		*p*-value	
	n	%	n	%		n	%	n	%		
Vital status											
alive	4,574	97.6	1,893	96.8	p = 0.11	5,800	98.7	2,680	97.9	p < 0.01	p < 0.001
deceased	114	2.4	62	3.2		74	1.3	57	2.1		
SRH											
poor	412	8.8	179	9.2	p = 0.24	465	7.9	256	9.4	p < 0.01	p < 0.001
fair	775	16.5	357	18.3		1,128	19.2	569	20.8		
good	2,989	63.8	1,201	61.4		3,815	64.9	1,703	62.2		
very good	512	10.9	218	11.2		466	7.9	209	7.6		
Degree of pain											
0 point	1,283	27.4	528	27.0		1,148	19.5	536	19.6		
1 point	1,377	29.4	621	31.8	p = 0.49	1,693	28.8	805	29.4	p = 0.88	p < 0.001
higher than 1 point	2,028	43.3	806	41.2		3,033	51.6	1,396	51.0		
Comorbidity											
0 point	1,830	39.0	767	39.2		2,305	39.2	951	34.7		
1 point	2,060	43.9	843	43.1	p = 0.88	2,713	46.2	1,330	48.6	p < 0.001	p = 0.87
higher than 1 point	798	17.0	345	17.6		856	14.6	456	16.7		
IADL disability											
0 point	2,984	63.7	1,178	60.3		3,898	66.4	1,573	57.5		
1 point	1,298	27.7	567	29.0	p < 0.05	1,373	23.4	718	26.2	p < 0.001	p < 0.05
higher than 1 point	406	8.7	210	10.7		603	10.3	446	16.3		
Bedridden status											
1 point	3,973	84.7	1,601	81.9		4,982	84.8	2,193	80.1		
2 point	493	10.5	246	12.6	p < 0.01	629	10.7	391	14.3	p < 0.001	p = 0.53
3 point	222	4.7	108	5.5		263	4.5	153	5.6		
Annual income											
0-1 million	769	16.4	433	22.1		1,753	29.8	928	33.9		
1-3 million	2,569	54.8	1,060	54.2	p < 0.001	3,176	54.1	1,513	55.3	p < 0.001	p < 0.001
higher than 3 million	1,350	28.8	462	23.6		945	16.1	296	10.8		

Table 3.6: Distribution of observed variables by geographic location.

Variables	Geographic location						*p* - value
	Village (n = 1,402)		Town (n = 9,825)		City (n = 4,027)		
	n	%	n	%	n	%	
Vital status							
alive	1,383	98.6	9,592	97.6	3,972	98.6	$p < 0.001$
deceased	19	1.4	233	2.4	55	1.4	
SRH							
poor	122	8.7	879	8.9	311	7.7	$p < 0.01$
fair	269	19.2	1,870	19.0	690	17.1	
good	864	61.6	6,188	63.0	2,656	66.0	
very good	147	10.5	888	9.0	370	9.2	
Degree of pain							
0 point	342	24.4	2,064	21.0	1,089	27.0	
1 point	459	32.7	2,656	27.0	1,381	34.3	$p < 0.001$
higher than 1 point	601	42.9	5,105	52.0	1,557	38.7	
Comorbidity							
0 point	528	37.7	3,730	38.0	1,595	39.6	
1 point	674	48.1	4,429	45.1	1,843	45.8	$p < 0.01$
higher than 1 point	200	14.3	1,666	17.0	589	14.6	
IADL disability							
0 point	760	54.2	5,979	60.9	2,894	71.9	
1 point	449	32.0	2,707	27.6	800	19.9	$p < 0.001$
higher than 1 point	193	13.8	1,139	11.6	333	8.3	
Bedridden status							
1 point	1,136	81.0	8,157	83.0	3,456	85.8	
2 point	195	13.9	1,158	11.8	406	10.1	$p < 0.001$
3 point	71	5.1	510	5.2	165	4.1	
Annual income							
0-1 million	477	34.0	2,490	25.3	916	22.7	
1-3 million	766	54.6	5,340	54.4	2,212	54.9	$p < 0.001$
higher than 3 million	159	11.3	1,995	20.3	899	22.3	

Significant differences were found between different SRH and the five observed variables listed in Table 3.7 ($p < 0.001$). The elderly who reported a lower degree of pain, comorbidity, physical disability and higher income level rated their health as "good" or "very good".

Table 3.7: Distribution of observed variables by SRH.

Variables	Self-rated health								*p*-value
	Poor (n = 1,312)		Fair (n = 2,829)		Good (n = 9,708)		Very good (n = 1,405)		
	n	%	n	%	n	%	n	%	
Degree of pain									
0 point	168	12.8	296	10.5	2,304	23.7	727	51.7	
1 point	262	20.0	717	25.3	3,161	32.6	356	25.3	p < 0.001
higher than 1 point	882	67.2	1,816	64.2	4,243	43.7	322	22.9	
Comorbidity									
0 point	145	11.1	500	17.7	4,238	43.7	970	69.0	
1 point	654	49.8	1,514	53.5	4,379	45.1	399	28.4	p < 0.001
higher than 1 point	513	39.1	815	28.8	1,091	11.2	36	2.6	
IADL disability									
0 point	343	26.1	1,468	51.9	6,794	70.0	1,028	73.2	
1 point	405	30.9	890	31.5	2,357	24.3	304	21.6	p < 0.001
higher than 1 point	564	43.0	471	16.6	557	5.7	73	5.2	
Bedridden status									
1 point	628	47.9	2,114	74.7	8,711	89.7	1,296	92.2	
2 point	304	23.2	530	18.7	835	8.6	90	6.4	p < 0.001
3 point	380	29.0	185	6.5	162	1.7	19	1.4	
Annual income									
0-1 million	452	34.5	922	32.6	2,219	22.9	290	20.6	
1-3 million	710	54.1	1,485	52.5	5,373	55.3	750	53.4	p < 0.001
higher than 3 million	150	11.4	422	14.9	2,116	21.8	365	26.0	

In all subjects, significant differences were found between different income levels and the five observed variables listed in Table 3.8 ($p < 0.001$). Participants who passed away within the follow-up period were mostly from the low income group (0-1 million yen). In addition, elderly in the lower income level also scored higher for the degree of pain, comorbidity, IADL disability and bedridden status.

Table 3.8: Distribution of observed variables by annual income.

Variables	Annual income						*p* - value
	0-1 million (n = 3,883)		1-3 million (n = 8,318)		higher than 3 million (n = 3,053)		
	n	%	n	%	n	%	
Degree of pain							
0 point	750	19.3	1,912	23.0	833	27.3	p < 0.001
1 point	1,199	30.9	2,439	29.3	858	28.1	
higher than 1 point	1,934	49.8	3,967	47.7	1,362	44.6	
Comorbidity							
0 point	1,351	34.8	3,264	39.2	1,238	40.6	p < 0.001
1 point	1,855	47.8	3,744	45.0	1,347	44.1	
higher than 1 point	677	17.4	1,310	15.7	468	15.3	
IADL disability							
0 point	1,896	48.8	5,354	64.4	2,383	78.1	p < 0.001
1 point	1,258	32.4	2,166	26.0	532	17.4	
higher than 1 point	729	18.8	798	9.6	138	4.5	
Bedridden status							
1 point	2,967	76.4	6,984	84.0	2,798	91.6	p < 0.001
2 point	627	16.1	962	11.6	170	5.6	
3 point	289	7.4	372	4.5	85	2.8	
Vital status							
alive	3,762	96.9	8,169	98.2	3,016	98.8	p < 0.001
deceased	121	3.1	149	1.8	37	1.2	

3.3.3 Factors Associated with Mortality

The estimated survival rates of all subjects during the follow-up period were calculated by Kaplan-Meier method. The differences between each observed variable were significant by log-rank test ($p < 0.001$), except for the degree of pain. For example, Figure 3.4 shows the significant survival differences by income level for both men and women ($p < 0.001$), indicating that compared with elderly men, elderly women not only lived longer, but also showed a smaller gap between different income levels.

The observed variables were entered into a univariate Cox regression model and all category variables were converted to a set of dichotomous variables indicating presence versus absence of the categories. Table 3.9.1 shows the mortality hazard ratios according to each variable by gender. The significant associations of poorer physical health and lower income level with higher mortality were observed both among men and women, except the degree of pain. Considering each physical health indicator, the effect of physical health on mortality was stronger for men. In addition, there was no significant association with income level (1-3 million versus higher than 3 million) and mortality for men.

Table 3.9.2 shows the mortality hazard ratios according to each variable by age. Compared with old-old elderly, the effects of comorbidity, IADL disability, bedridden status and income level on mortality were higher for young-old elderly. There was no significant association between income and mortality for the old-old elderly.

Table 3.9.3 shows the mortality hazard ratios according to each variable by geographic location. As the data from villages show abnormal results, only results for town and city were presented. Compared with the elderly living in towns, the effects of comorbidity, IADL disability (1 point versus 0 point) and income level were stronger for those living in cities, while other variables showed weak effects.

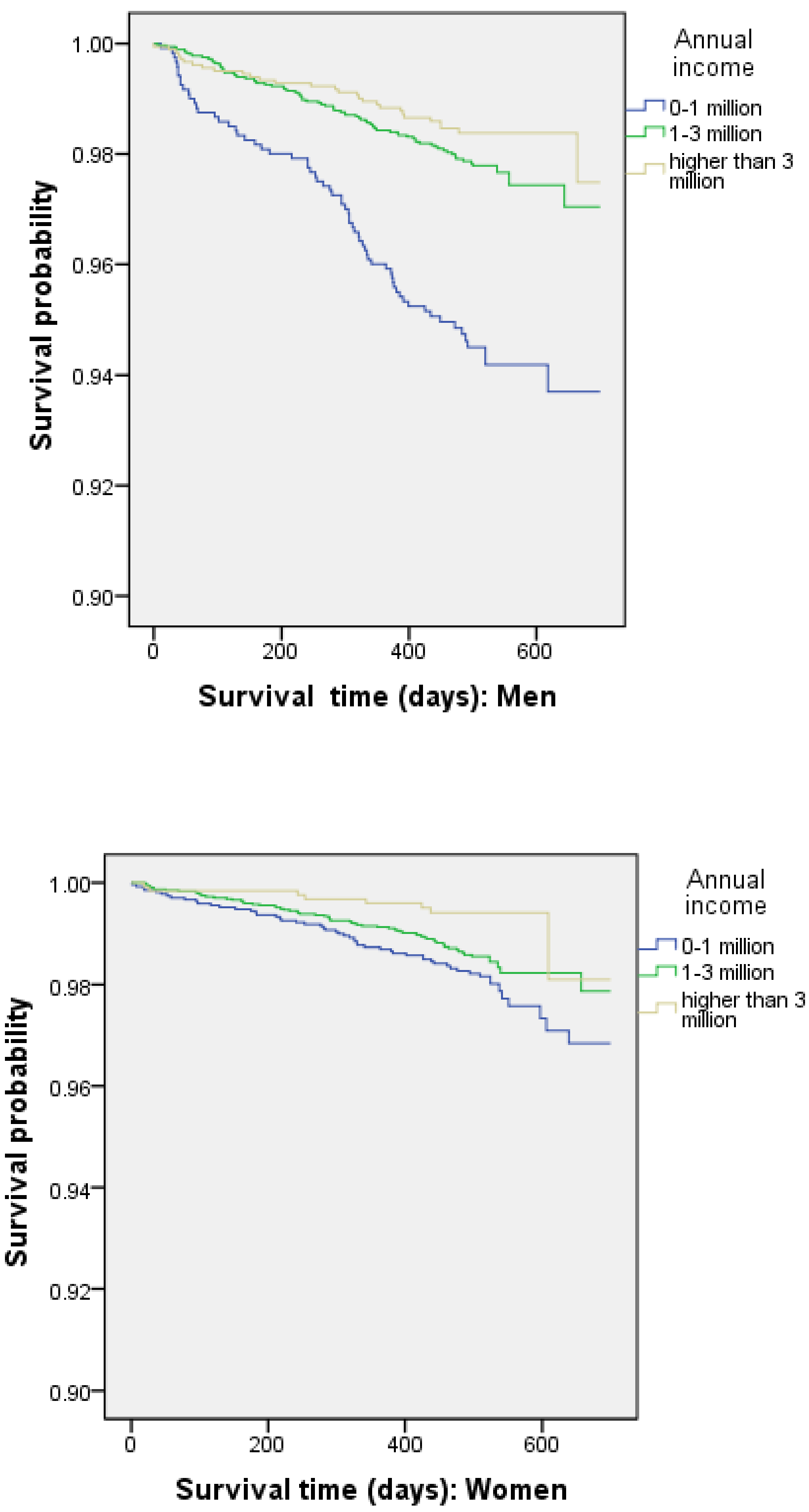

Figure 3.4: Kaplan-Meier survival curves according to income level for elderly men and women.

Table 3.9.1: Independent association of each variable with mortality in crude model by gender.

Predictor variable	Men				Women			
	Hazard ratio	95% CI		*p*-value	Hazard ratio	95% CI		*p*-value
		Lower	Upper			Lower	Upper	
Degree of pain (ref: 0 point)								
1 point	1.053	0.704	1.576	0.802	1.445	0.872	2.394	0.153
higher than 1 point	1.201	0.830	1.737	0.331	1.061	0.650	1.732	0.813
Comorbidity (ref: 0 point)								
1 point	2.168	1.477	3.181	0.000	1.882	1.210	2.926	0.005
higher than 1 point	3.021	1.967	4.639	0.000	3.044	1.846	5.021	0.000
IADL disability (ref: 0 point)								
1 point	2.188	1.515	3.160	0.000	2.421	1.599	3.666	0.000
higher than 1 point	7.319	5.094	10.518	0.000	4.366	2.843	6.706	0.000
Bedridden status (ref: 1 point)								
2 point	2.703	1.808	4.042	0.000	1.810	1.121	2.921	0.015
3 point	10.030	7.104	14.159	0.000	5.400	3.452	8.448	0.000
Income level (ref: higher than 3 million)								
0-1 million	3.445	2.226	5.333	0.000	2.905	1.382	6.108	0.005
1-3 million	1.349	0.881	2.064	0.168	2.136	1.026	4.446	0.043

Table 3.9.2: Independent association of each variable with mortality in crude model by age.

Predictor variable	Young-old				Old-old			
	Hazard ratio	95% CI		*p*-value	Hazard ratio	95% CI		*p*-value
		Lower	Upper			Lower	Upper	
Degree of pain (ref: 0 point)								
1 point	1.322	0.889	1.966	0.169	0.918	0.554	1.522	0.741
higher than 1 point	1.068	0.730	1.564	0.734	1.021	0.644	1.620	0.928
Comorbidity (ref: 0 point)								
1 point	2.039	1.409	2.953	0.000	1.909	1.199	3.038	0.006
higher than 1 point	3.385	2.245	5.104	0.000	2.523	1.477	4.307	0.001
IADL disability (ref: 0 point)								
1 point	2.343	1.648	3.330	0.000	2.233	1.435	3.475	0.000
higher than 1 point	6.572	4.634	9.321	0.000	4.086	2.597	6.427	0.000
Bedridden status (ref: 1 point)								
2 point	2.514	1.701	3.715	0.000	1.799	1.092	2.962	0.021
3 point	8.484	6.019	11.959	0.000	6.575	4.231	10.217	0.000
Income level (ref: higher than 3 million)								
0-1 million	3.398	2.078	5.559	0.000	1.371	0.781	2.405	0.271
1-3 million	1.769	1.090	2.872	0.021	0.952	0.553	1.639	0.860

Table 3.9.3: Independent association of each variable with mortality in crude model by geographic location.

Predictor variable	Village				Town				City			
	Hazard ratio	95% CI		*p* -value	Hazard ratio	95% CI		*p* -value	Hazard ratio	95% CI		*p* -value
		Lower	Upper			Lower	Upper			Lower	Upper	
Degree of pain (ref: 0 point)												
1 point	6.843	0.867	54.019	0.068	1.002	0.701	1.434	0.990	1.378	0.678	2.800	0.376
higher than 1 point	5.295	0.670	41.815	0.114	0.883	0.635	1.229	0.461	1.273	0.630	2.572	0.501
Comorbidity (ref: 0 point)												
1 point	2.371	0.765	7.353	0.135	1.787	1.289	2.476	0.000	3.337	1.534	7.259	0.002
higher than 1 point	1.998	0.447	8.928	0.365	2.770	1.922	3.992	0.000	5.366	2.297	12.540	0.000
IADL disability (ref: 0 point)												
1 point	2.867	1.042	7.889	0.041	2.152	1.547	2.993	0.000	2.746	1.533	4.920	0.001
higher than 1 point	2.000	0.500	7.999	0.327	6.542	4.775	8.963	0.000	2.952	1.383	6.300	0.005
Bedridden status (ref: 1 point)												
2 point	—	—	—	—	2.626	1.867	3.693	0.000	1.987	0.920	4.292	0.081
3 point	3.022	0.881	10.371	0.079	8.205	6.017	11.188	0.000	8.179	4.316	15.499	0.000
Income level (ref: higher than 3 million)												
0-1 million	—	—	—	—	2.206	1.475	3.300	0.000	3.832	1.438	10.211	0.007
1-3 million	—	—	—	—	1.199	0.807	1.782	0.368	2.408	0.934	6.205	0.069

3.3.4 Factors Associated with SRH

Two observed variables (annual income and SRH) and two latent variables (chronic illness and physical disability) were subjected to SEM analysis. The statistically best-fitting models were selected and specified causal relationships among each variable.

Structural Equation Modeling by Gender

First, separated models for all participants by gender were calculated (Figures 3.5.1 and 3.5.2). The data were well fit to the models with goodness-of-fit indices as follows: NFI = 0.985, CFI = 0.986, IFI = 0.986 and RMSEA = 0.026 for both elderly men and women. SRH was well-explained by annual income, chronic illness and physical disability (R^2 = 0.59 for elderly men and R^2 = 0.53 for elderly women). The model depicted the pathways leading from annual income via chronic illness and physical disability to the endogenous observed SRH; moreover, chronic illness and physical disability were directly linked to SRH.

Table 3.10.1 shows the standardized effects of annual income, chronic illness and physical disability on SRH. The standardized direct effects of chronic illness on SRH were -0.533 for elderly men and -0.525 for elderly women. Likewise, the standardized direct effects of physical disability on SRH were -0.371 for elderly men and -0.321 for elderly women. Annual income played an indirect role on SRH; the standardized effects on SRH were 0.150 for elderly men and 0.120 for elderly women. In addition to a direct effect, chronic illness also indirectly affected SRH via physical disability (-0.147 for elderly men and -0.142 for elderly women).

Table 3.10.2 shows the standardized estimates of annual income effect on chronic illness and physical disability. The direct effects of annual income on physical disability were stronger than the effects on chronic illness for both elderly men and women.

Compared with women, all standardized effects were stronger on men except for the direct effects of income on chronic illness. Regarding the gender differences by the pairwise comparison, path coefficients from income to physical disability (CR = 2.049) and from physical disability to SRH (CR = 2.119) were statistically significant at $p < 0.05$. However, other path coefficients showed no statistically significant differences by gender, with CRs < 1.96.

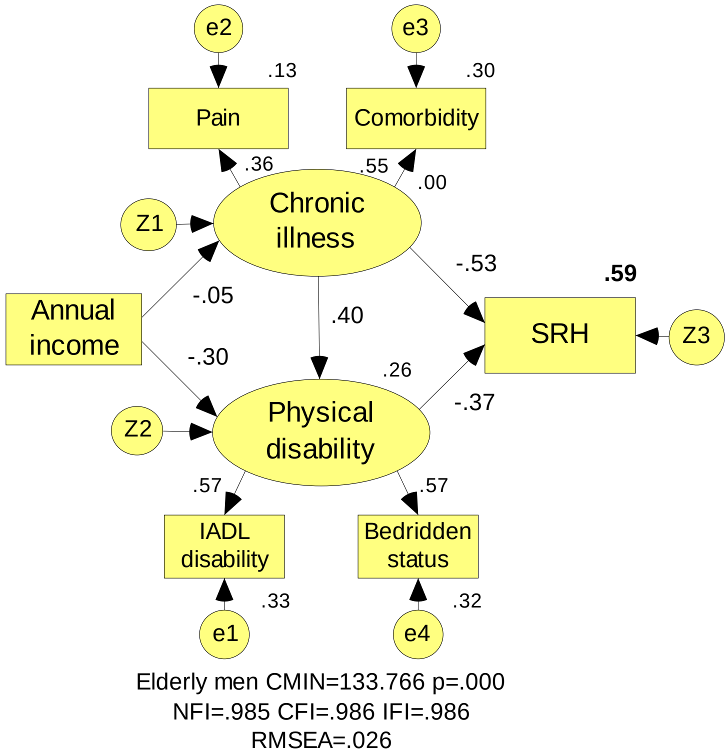

Figure 3.5.1: Structural relationships among annual income, chronic illness, physical disability and SRH for elderly men.

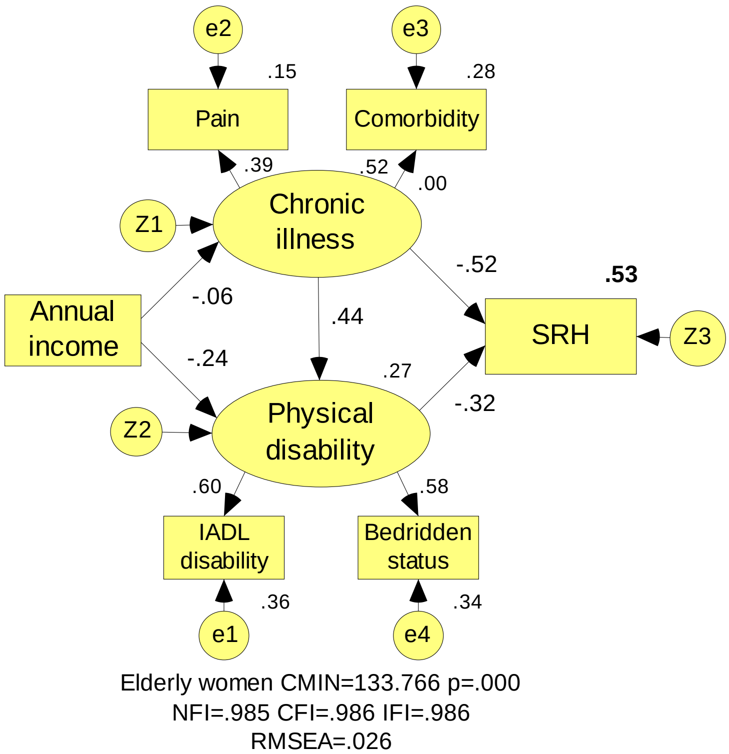

Figure 3.5.2: Structural relationships among annual income, chronic illness, physical disability and SRH for elderly women.

Table 3.10.1: Standardized effects of annual income, chronic illness, and physical disability on SRH by gender.

Standardized effects	SES		Chronic illness		Physical disability	
	Men	**Women**	**Men**	**Women**	**Men**	**Women**
Direct	—	—	-0.533	-0.525	-0.371	-0.321
Indirect	0.150	0.120	-0.147	-0.142	—	—
Total	0.150	0.120	-0.680	-0.667	-0.371	-0.321

Table 3.10.2: Standardized effects of annual income on chronic illness and physical disability by gender.

Standardized effects	Chronic illness		Physical disability	
	Men	**Women**	**Men**	**Women**
Direct	-0.054	-0.063	-0.304	-0.243
Indirect	—	—	-0.021	-0.028
Total	-0.054	-0.063	-0.325	-0.270

Structural Equation Modeling by Age

Next, separated models for all participants by age were calculated (Figures 3.6.1 and 3.6.2). The models fit the data very well, with a NFI of 0.985, a CFI of 0.986, an IFI of 0.986 and a RMSEA of 0.026. All of the loadings included in the models were statistically significant ($p < 0.001$). SRH was well-explained by annual income, chronic illness and physical disability ($R^2 = 0.57$ for the young-old elderly and $R^2 = 0.54$ for the old-old elderly). These models describe pathways: (1) starting from annual income via chronic illness leading to SRH; (2) starting from annual income via physical disability leading to SRH; (3) starting from annual income via chronic illness and physical disability leading to SRH; (4) staring from chronic illness leading to SRH via physical disability; (5) and (6) two direct pathways from chronic illness and physical disability leading to SRH.

The effects of each variable on SRH were shown in Table 3.11.1. Overall, chronic illness was the strongest determinant of SRH (-0.546 for young-old elderly and -0.496 for old-old elderly), followed by physical disability (-0.332 for young-old elderly and -0.361 for old-old elderly). Annual income did not exhibit direct effects on SRH, but did show indirect effects via chronic illness and physical disability (0.134 for young-old elderly and 0.138 for old-old elderly).

Table 3.11.2 shows the standardized estimates of annual income effect on chronic illness and physical disability. Annual income was observed to be significantly predictive of chronic illness and physical disability, and the effects on physical disability were stronger for both young-old and old-old elderly.

Regarding the age comparison by pairwise comparison, all path coefficients were not statistically significant with CRs < 1.96.

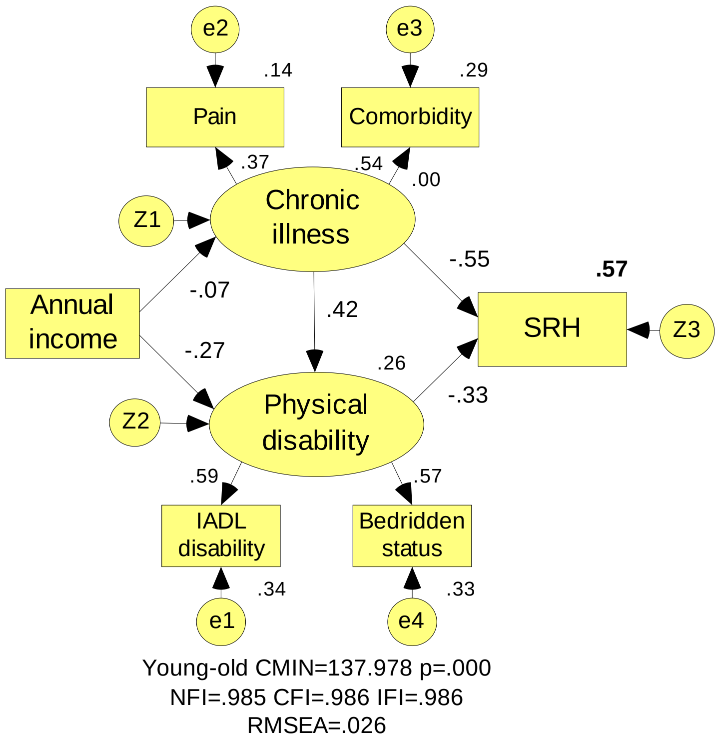

Figure 3.6.1: Structural relationships among annual income, chronic illness, physical disability and SRH for young-old elderly.

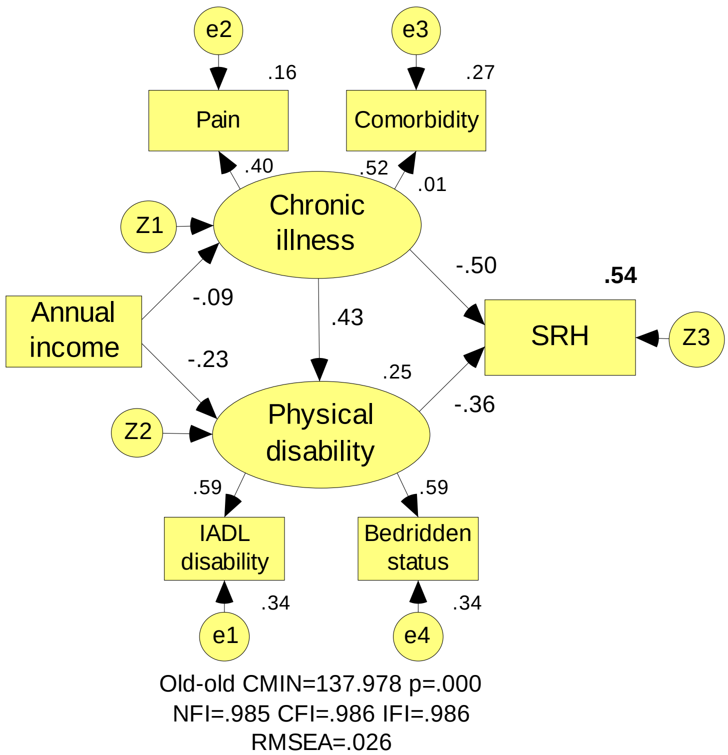

Figure 3.6.2: Structural relationships among annual income, chronic illness, physical disability and SRH for old-old elderly.

Table 3.11.1: Standardized effects of annual income, chronic illness, and physical disability on SRH by age.

Standardized effects	SES		Chronic illness		Physical disability	
	Young-old	Old-old	Young-old	Old-old	Young-old	Old-old
Direct	—	—	-0.546	-0.469	-0.332	-0.361
Indirect	0.134	0.138	-0.140	-0.153	—	—
Total	0.134	0.138	-0.686	-0.649	-0.332	-0.361

Table 3.11.2: Standardized effects of annual income on chronic illness and physical disability by age.

Standardized effects	Chronic illness		Physical disability	
	Young-old	Old-old	Young-old	Old-old
Direct	-0.065	-0.086	-0.267	-0.229
Indirect	—	—	-0.028	-0.037
Total	-0.065	-0.086	-0.295	-0.266

Structural Equation Modeling by Location

Figures 3.7.1, 3.7.2 and 3.7.3 show the models for the subjects living in villages, towns and cities, respectively. The models fit the data very well (NFI = 0.981, CFI = 0.983, IFI = 0.983 and RMSEA = 0.024). SRH was well-explained by the three variables included in the models (R^2 = 0.52 for the subjects lived in villages, R^2 = 0.55 for the subjects lived in towns and R^2 = 0.58 for the subjects lived in cities). These models describe the same pathways as in the models separated by gender and age.

Standardized estimates of the different variables on SRH by area are included in Table 3.12.1. Overall, chronic illness was the strongest determinant of SRH (-0.594 for the elderly lived in villages, -0.501 for the elderly lived in towns and -0.587 for the elderly lived in cities), followed by physical disability (-0.205 for the elderly lived in villages, -0.378 for the elderly lived in towns and -0.288 for the elderly lived in cities). The direct standardized effect of chronic illness on SRH was strongest for the elderly living in villages, followed by those living in cities. Likewise, the direct standardized effect of physical disability on SRH was strongest for the elderly living in towns, followed by those living in cities.

Table 3.12.2 shows the standardized estimates of annual income effect on chronic illness and physical disability. The direct effect of annual income on chronic illness was strongest for the elderly lived in villages (-0.125), and the direct effect on physical disability was strongest for the elderly lived in towns (-0.268).

Regarding area comparisons, all standardized effects were similar among three groups, and the differences were not statistically significant, with all CRs < 1.96.

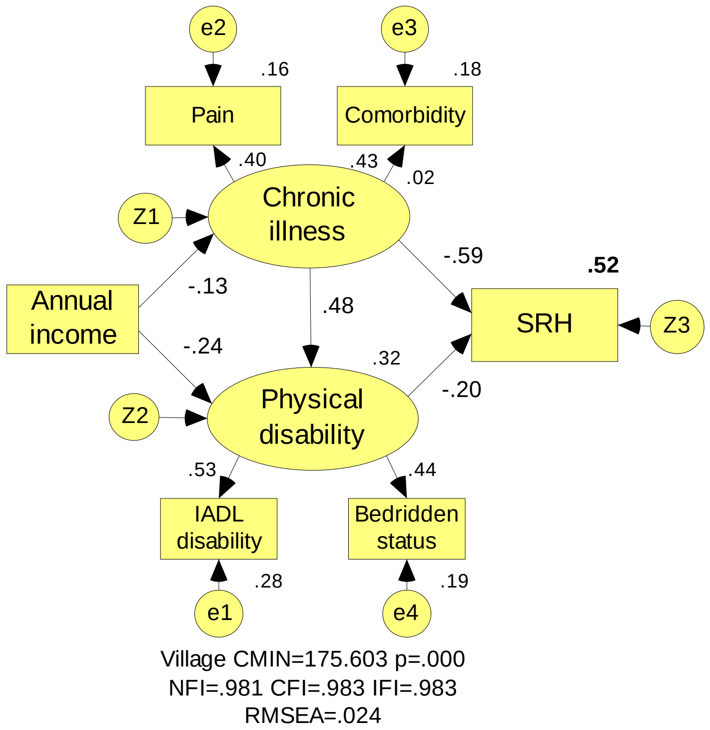

Figure 3.7.1: Structural relationships among annual income, chronic illness, physical disability and SRH for the elderly lived in villages.

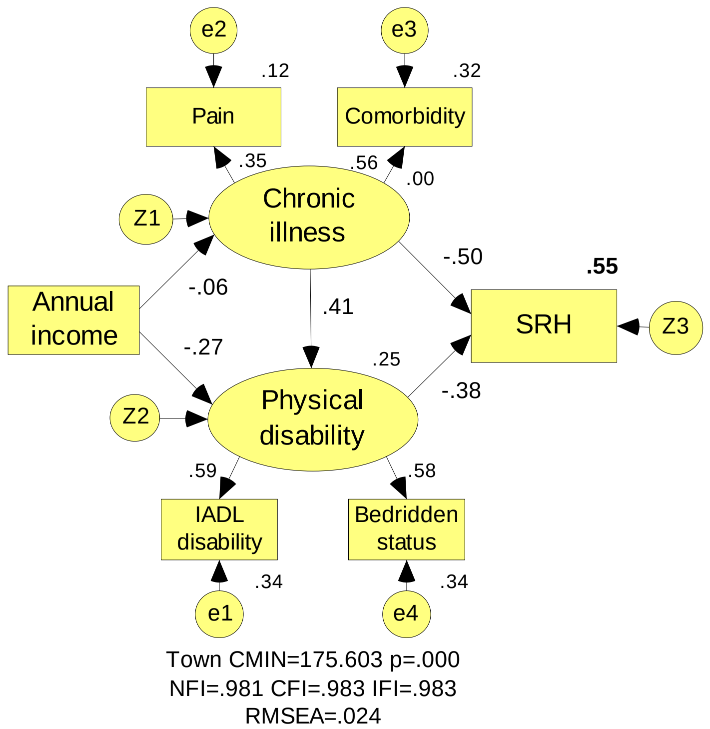

Figure 3.7.2: Structural relationships among annual income, chronic illness, physical disability and SRH for the elderly lived in towns.

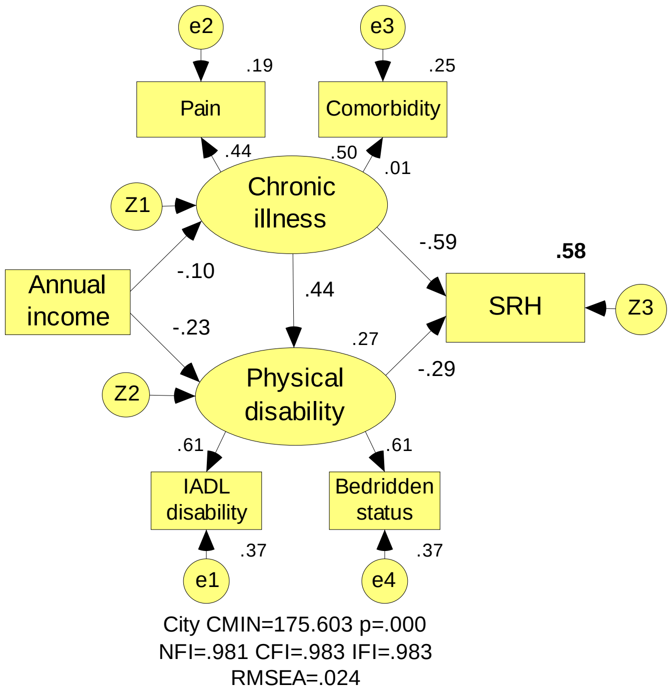

Figure 3.7.3: Structural relationships among annual income, chronic illness, physical disability and SRH for the elderly lived in cities.

Table 3.12.1: Standardized effects of annual income, chronic illness, and physical disability on SRH by geographic location.

Standardized effects	SES			Chronic illness			Physical disability		
	Village	Town	City	Village	Town	City	Village	Town	City
Direct	—	—	—	-0.594	-0.501	-0.587	-0.205	-0.378	-0.288
Indirect	0.135	0.138	0.134	-0.099	-0.154	-0.128	—	—	—
Total	0.135	0.138	0.134	-0.693	-0.655	-0.715	-0.205	-0.378	-0.288

Table 3.12.2: Standardized effects of annual income on chronic illness and physical disability by geographic location.

Standardizes effects	Chronic illness			Physical disability		
	Village	Town	City	Village	Town	City
Direct	-0.125	-0.057	-0.096	-0.236	-0.268	-0.228
Indirect	—	—	—	-0.061	-0.023	-0.042
Total	-0.125	-0.057	-0.096	-0.296	-0.291	-0.270

3.4 Discussions

This follow-up study compared correlates of SES, physical health and HALE of the elderly people in 16 municipalities. The results show significant differences in the distribution of selected variables among subgroups by gender, age and geographic location. Despite both SRH and mortality being indicators of HALE, their respective factors were not the same: the degree of pain was associated with SRH but not with mortality, while there were significant, direct relationships between income level and mortality in the Cox regression models, but not with SRH in the structural equation models.

In this study, the overall survival rate of all participants was 98% during 1998-2000. Among the various causes of death, cancer was the most frequent, followed by heart disease, infectious disease and cerebrovascular disease, and the remaining 21.2% were classified as “others”. Based on the results of survival analysis, those dying within the follow-up period had worse physical health status; in detail, compared with the elderly who had no disease, no IADL disability and no bedridden, the elderly who had disability and disease at different levels had a higher risk of death. For all subjects, annual income was a significant predictor of mortality, and the hazard ratios became stronger and more significant after controlling for gender, age and geographic location. This is in agreement with most studies that reported a strong relationship between poorer physical health and SES with mortality.

This study demonstrated that physical health (indicated by two latent variables chronic illness and physical disability) was a strong predictor of SRH. This finding is supported by some studies showing that SRH of older persons was found to be highly correlated with chronic diseases or symptoms[20-23] and functional decline or disability[24-27]. In addition, there is a consistent inverse relationship between SES and disability worldwide[28]. This study also indicated stronger direct effects of annual income on physical disability and chronic illness. In the preliminary analysis, interaction between SRH and annual income was significant. However, the SEM highlighted the indirect relationship between income and SRH. Income is believed to promote good health by affecting access to adequate physical health care, environment quality, nutrition and healthy lifestyle. Future studies should explore the indirect relationships by using the aforementioned indicators.

The most important findings of this study are the gender, age, and location differences in the structural relationships between SES, physical health, and HALE of elderly people in Japan. Compared to men, women tend to experience more chronic illness and functional disability, and older women have better chances of survival than older men, given a specific health state[29]. According to Deeg et al.[30], older women have lived longer and will consider it more likely that they will live longer with health problems than men will when they have to respond to the SRH questions. In this study, although elderly women lived longer, they also reported more pain, more IADL disability and were more seriously bedridden than elderly men. Moreover, elderly women had worse SRH than elderly men (Table 3.5). The physical health differentials in both mortality and SRH are generally more pronounced and statistically significant among elderly men than among elderly women. Although income affected SRH indirectly, income differentials in both mortality and SRH are also more pronounced among elderly men subjects. This result is consistent with findings from the United States, Canada, France, Hungary, England and Wales, and the Nordic nations[31-33].

Previous studies indicated that health eventually converges across different SES, because people inevitably weaken and die in old age, regardless of social class[34]. This study showed income differentials in mortality interacted with age, and these results are consistent with prior findings suggesting the diminishing SES effects on health. As Table 3.9.2 shows, the effect of annual income on mortality was stronger and significant for the young-old elderly, rather than the old-old elderly. Although the structural relationships between annual income, physical health, and SRH showed the age comparison was not significant, the path coefficients were similar for both age groups. Thus, the study verified the convergence hypothesis of SES differences in health. In addition to gender and age comparison, this study showed a significant distribution of annual income, physical health, mortality, and SRH by geographic area. Compared with the elderly living in villages and towns, the elderly living in cities had higher income, had less pain, disease and physical disability, and had better SRH. Furthermore, the effects of physical health and annual income on mortality were stronger for the elderly living in cities. Geographic location represents general socio-demographic level, and showed a significant effect on the health status of elderly people. The strong association between a decreased life expectancy and lower socioeconomic conditions was indicated in a previous study using municipal data in Japan[17]. However, there was no statistically significant difference in the structural relationships between SES, physical health, and SRH. This is likely due to the fact that the municipalities were classified into three levels according to the administrative divisions of Japan, but there was no classification of urban and rural area in this study.

Some limitations of this study should be noted. First, the baseline survey conducted in 16 municipalities lasted nearly two years, so the follow-up time was inconsistent among all subjects. Secondly, studies have indicated a higher non-response rate among individuals with poor physical health and lower income. In our study, it was decided that missing data was to be replaced by the mean value of each variable, and so the result might lead to an underestimate of the prevalence of the variables. Lastly, the data on SES were collected only by individual annual income: the effect of other SES indicators, such as education and occupation, could not be explained.

3.5 Conclusions

In conclusion, the results revealed SES as the determinant of physical health and HALE: lower SES of the elderly was associated with an increase in mortality, directly, and a decrease in SRH, indirectly, via physical health status. The significant distributions of SES, physical health, and HALE were found by gender, age and geographic location among the elderly people in Japan.

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Chapter 4

Healthy Life Expectancy in Relation to the Socioeconomic Status, Physical Health and Long-term Care among Japanese Elderly

4.1 Introduction

The size and proportion of the aging population is increasing worldwide due to increasing longevity and declining birth rates. Japan is the most rapidly aging society in the world. In 1990, elderly people (≥ 65 years old) represented 12% of the Japanese general population, and this figure is projected to rise to around 40% in 2050. Japan currently also has the longest life expectancy (LE) at birth (79.4 years for men and 85.9 years for women in 2011)[1]. However, with an increasing aging population comes an increasing number of older people who are bedridden, have dementia, and/or are in need of long-term care (LTC). Thus, whether longer life expectancy is accompanied by good health among aging population is becoming a great concern.

In 1997, the World Health Organization (WHO) stressed health expectancy as more important than life expectancy in its World Health Report[2]; since 2000, estimates of healthy life expectancy (HALE) have been published for its member states by calculating the equivalent number of years in full health that a person can expect to live, based on the current mortality rates and prevalence distribution of health states in the population[3]. Japan has the longest HALE in the world (70.4 years for men and 73.6 for women in 2010), which was defined as the number of years spent free of activity limitation[4]. Past research has calculated HALE with Sullivan's method to show that an individual can expect to live in a healthy state measured by a series of indicators ranging from objective measures of physiology, disease, and functional status, to subjective measures such as self-rated health (SRH). Although HALE is becoming a standard summary of population full health at both the international and national level in a variety of applications, including highlighting health inequalities, targeting resources for health promotion, evaluating the impact of health policies, and planning for health, social, and fiscal policy[5], there are few detailed studies that have objectively and systematically assessed the overall HALE for the elderly, which is calculated by combining the individual vital status and SRH status.

A great deal of attention has been paid to factors associated with the longest HALE in Japan, in part because of the country's universal health insurance, compulsory primary education and a general healthy lifestyle. In addition, Japan is not only one of the most affluent countries in terms of gross national income per capita, but also has less apparent social inequalities rather than Western countries[6]. A series of national health promotion policies accompanied by prefectural and municipal health promotion plans, such as “Health Japan 21,” aim to extend HALE and reduce disparities by gender, socioeconomic factors and geographic areas[7]. However, the association between socioeconomic status (SES) and HALE is still disputed in Japan. A previous study showed that decrease in yearly income and daily activity, as well as poor social support, especially in the elderly, could disrupt the balance of health[8]. The results of a related ecological study indicated the health status of older people was substantially decreased by disadvantageous SES measured by per capita income and unemployment rate[9]. In contrast, it has been reported that in Okinawa, which ranks at the top in life expectancy for women but at a bottom in socioeconomic indicators, living a healthy lifestyle is much more important than socioeconomic factors. The magnitude of SES differences in HALE appears to be influenced by the way in which status and health outcomes are measured[10].

In 2000, the Japanese government implemented public long-term care (LTC) insurance available to those aged 65 years and older who require sustained nursing care and to those aged 40-64 years with one of 15 specified diseases. From 2000 to 2010, the number of people certified as requiring LTC increased by about 2.69 million (123%)[11]. An analysis of national survey data before and after the program was initiated showed an increased use of formal care at lower cost to households, but mixed results for its effects on personal careers[12]. Evidence from micro-level household data suggests that introducing the LTC system helped Japanese households to reduce income losses associated with a disabled family member[13]. However, the increased demand for LTC will result in an increased cost to society, which raises concerns regarding the control of health-related expenditures. Therefore, it is necessary to explore factors that are associated with this increased demand for LTC.

In the LTC field, there is a consensus that disability among the elderly is the main factor driving the demand for LTC services[14]. Much evidence has also suggested that people in poorer physical health are more likely to die[15] and activity disability is most common among the elderly. Globally, disability prevalence rates have been falling among the elderly[16], and Japan is no exception: Japanese disability prevalence rates declined 16.5% over a 10-year period from 1993 to 2002[17]. However, another study on the trends of disability-free life expectancy from 1995 to 2004 showed that the duration of life with light or moderate disability increased in both Japanese males and females[18]. Using the ratio of total number of elderly certified for LTC support/care versus total elderly population as a measure of disability prevalence, the disability status of the elderly population in Japan was 9.9% in 2000 versus 16.3% in 2006[19]. Although numerous studies have been made on the variables associated with increased health care needs, such as income, family context and health-related factors, little is known of the underlying mechanisms or processes of each factor by using structural equation modeling (SEM) in a chronological study.

To our knowledge, the relationships among SES, physical health, LTC, and HALE have not been rigorously studied for the elderly; thus, the purpose of this chronological study was to elucidate the effects of SES, physical health, and LTC on HALE among suburban elderly in Japan. A series of models explaining the structural relationships between several related factors were developed and validated by gender and age. Four hypotheses for HALE were examined: (1) SES would affect HALE either directly or indirectly; (2) LTC, as determined by SES and physical health, would directly affect HALE; (3) physical health, as determined by SES, would have a chronological effect on HALE; (4) gender and age differences in HALE, and its associated factors existed.

4.2 Material and Methods

4.2.1 Study Setting — Tama City

Tama City is located in the northern part of a large area of hills in south-western Tokyo, Japan, and was classified as a city in 1971. Its southern area forms 60% of Tama New Town and roughly 70% of Tama City’s population lives in Tama New Town, which was constructed in the late 1960s and 1970s to create integrated living-working communities and a pleasant urban environment on the outskirts of Tokyo. The residents were mostly middle-class citizens. Tama City had 30,672 inhabitants in 1970, and the number steadily increased until 1990, with the total population peaking at 145,677, in 1994, before sliding to 141,180 as of 2002; this figure has remained relatively stagnant, at around 144,000, over the past two decades (Figure 4.1). The decline appears steeper considering that fewer children are being born, and more of the younger generation has moved to the center of other big cities for better working and living conditions. Among its total population, the population aged ≥ 65 years old comprised approximately 3.6% in 1975, less than the national average of 7.9%. During 1975-1990, the aging rate increased slowly, but due to the predominant age group of newcomers to Tama City in the 1970s, the city's population is now rapidly aging, even faster than the national average. As Figure 4.1 shows, the aging rate in 1990 was 5.4%, with national average being 12.1%; this increased to 10.5% in 2000, with the national average increasing to 17.4%, and increased once again to 20.2% in 2010, with the national average moving up to 23.0%. In 2001, when this study was initiated, the study setting had a total population of 141,527, of whom 16,164 (11.4%) were aged 65 years or older.

Compared with the LE at birth of Tokyo, the LE at birth of Tama City was higher for both men and women, with women outliving men, e.g. by 6.2 years in 2005 and 5.7 years in 2010 (Figure 4.2). Although the aging rate of Tama City was 20.6% in 2011 (Table 4.1), the same as that of Tokyo and less the national aging rate (23.6%), the proportion (12.0%) of the elderly who required the LTC (or support) was less than the overall proportion in Tokyo (16.6%) and Japan (16.8%).

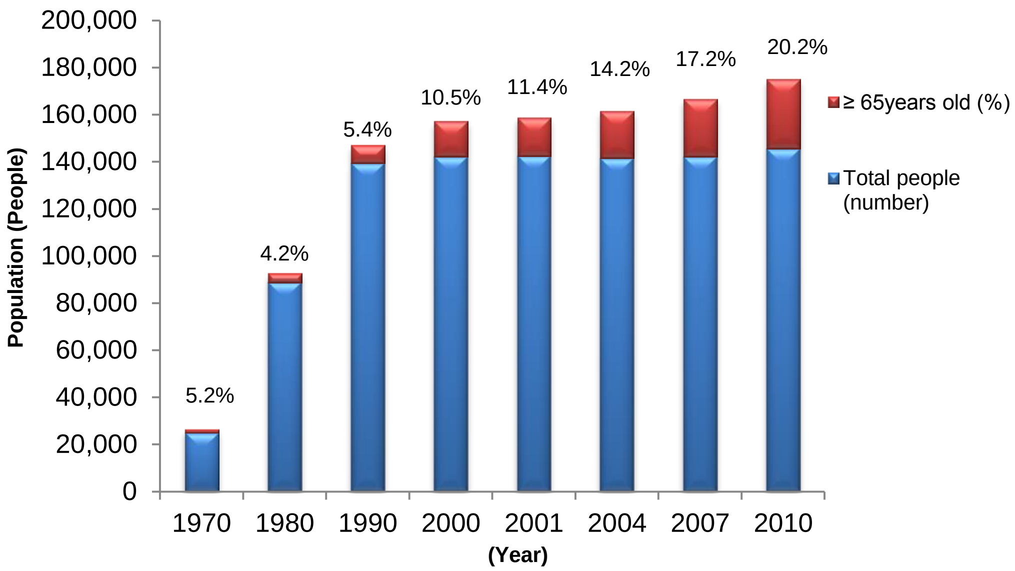


Figure 4.1: Population aged ≥ 65 years old in Tama City from 1970 to 2010. (Source: Tama City census, 2012[20].)

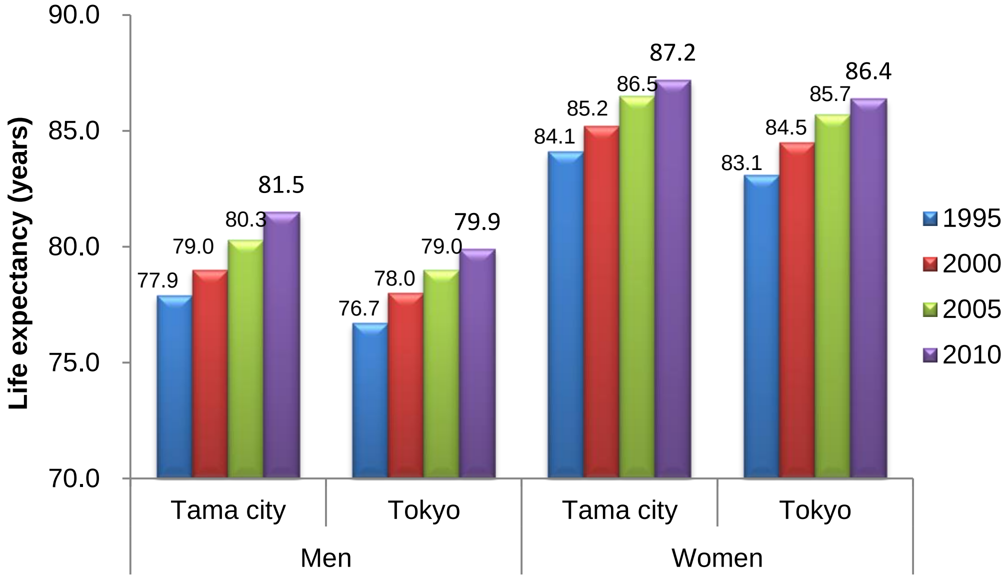


Figure 4.2: Life expectancy at birth in Tama City and Tokyo by gender. (Source: Ministry of Health, Labour and Welfare, 2012[1, 20].)

Table 4.1: Status of implementation of long-term care insurance system in Tama City, Tokyo and Japan in 2011. (Sources: Tama City census, 2012[20]; Cabinet Office, 2012[21]; Ministry of Health, Labor and Welfare, 2011[22].)

	Tama city	**Tokyo**	**Japan**
Total population (thousands)	147	12,869	126,180
Number of insured persons ⩾ 65 years (thousands) (aging rate %)	30 (20.6%)	2,615 (20.6%)	29,090 (23.1%)
Number of persons requiring LTC or support (thousands) (%)	3 (12.0%)	433 (16.6%)	4,872 (16.8%)

4.2.2 Study Subjects

In September 2001, a questionnaire survey was conducted among all non-institutionalized elderly (aged ≥ 65 years) residents of Tama City. A sample of 13,195 elderly returned and responded to the self-rated questionnaire by mail (response rate of 80.2%). In September 2004, a follow-up survey with the same content as the first survey was sent to the respondents from 2001. Overall, 505 people in this sample had moved, 914 had died, and 3,218 did not respond. We followed up the remaining 8,558 participants in the second survey until August 31, 2007, and collected data on their vital status through the municipal residents' registry. The data from both 2001 and 2004 surveys showed the prevalence of activity limitations and comorbidity among the elderly associated with advancing age, and the subjects aged ≥ 85 years showed sharply increased prevalence of activity limitation and comorbidity. Considering the large deviation in the measurement variables, we limited our analysis to those aged < 85 years, leaving a total of 7,905 subjects for analysis.

4.2.3 Data Collection

Healthy Life Expectancy (HALE)

In this study, we defined HALE as the expected time living with good or better SRH. We used a single global assessment question, of "How would you rate your general health: very good, good, fair or poor?" to measure SRH of the participants. This information was collected from the questionnaire conducted in 2004. Based on the vital status (alive or deceased) obtained from the municipal residents' registry, survival time was defined as the number of days alive from September 1, 2004 to August 1, 2007.

Long-term Care (LTC) Level

The category certification of LTC was evaluated according to the six levels designated by the Japanese Ministry of Health, Labour and Welfare in 2004, which include one support level and five care levels. A respondent that did not receive LTC scored 0, while a respondent scored 1 if assigned the lightest support level and 6 if assigned the most severe care level. All subjects were also divided into two simpler groups: “no-LTC needs” and “LTC needs.”

Physical Health

Physical health was quantified by physical disability and comorbidity. Physical disability was defined as a composite index of basic activity of daily living (BADL) and instrumental activity of daily living (BADL) with a high reliability (Cronbach’s α = 0.81). These indicators were collected from the questionnaire surveys conducted in 2001 and 2004. BADL included three items[23]: going to the toilet, taking a bath, and taking a walk outside (Cronbach’s α = 0.77), while IADL included five items[24]: reading, grocery shopping, meal preparation, money arrangement and insurance and pension management (Cronbach’s α = 0.88). Each item was rated on a 2-point response scale (0 = without assistance; 1 = requiring assistance) and summed. BADL scores ranged from 0 to 3 points, while IADL scores ranged from 0 to 5 points, with a higher score indicating a greater level of physical disability.

Comorbidity was measured by asking the participants if they had been diagnosed and were currently suffering from four selected diseases — hepatic diseases, diabetes mellitus, cardiovascular diseases, and cerebrovascular disease — which were significantly and negatively associated with the length of survival time of the subjects between September 2004 and August 2007. The data were collected from the questionnaire surveys administered in 2001 and 2004, and the total number of diseases reported was summed to create a continuous aggregate score of number of comorbidities, ranging from 0 to 4.

Socio-demographic Indicators

Socio-demographic information from all participants was obtained, including gender, age, educational level and annual income. All subjects were divided into two age groups: “young-old (65-74 years)” and “old-old (75-84 years)” (Table 2). Educational level and annual income were considered as two main components of SES. The respondents chose one of the four categories that best corresponded to their and their spouse’s total annual income in 2001 survey (1 = less than 1 million yen; 2 = between 1 million and 3 million yen; 3 = between 3 million and 7 million yen; 4 = more than 7 million yen). Educational level was a three-level ordinal variable (1 = graduated from junior high school; 2 = graduated from high school; 3 = graduated from junior college or higher). Although the educational attainment information was obtained only in 2004 survey, it was stable for the elderly in both 2001 and 2004.

Table 4.2: Study subjects by gender and age.

		Young-old		Old-old		Total
		65-69 years	70-74 years	75-79 years	80-84 years	
Men	n	1,814	1,074	585	281	3,754
	%	48.3	28.6	15.6	7.5	100
Women	n	1,775	1,141	834	401	4,151
	%	42.8	27.5	20.1	9.7	100
Total	n	3,589	2,215	1,419	682	7,905
	%	45.4	28	18	8.6	100

4.2.4 Statistical Methods

Basic descriptive statistics were generated for the entire sample and stratified by gender. A χ^2-test was used to determine whether the men and women were distributed differently among the categories. Then, factor analysis was applied to identify a few underlying factors from a large initial set of observed variables. The third analysis involved survival analysis, and estimated cumulative survival rates were calculated by Kaplan-Meier Method. A long-rank test was used for testing the association between survival and potential risk variables. The three analyses were undertaken by SPSS statistical software (Version 19.0 for Windows).

SEM with AMOS statistical software (Version 17.0 for Windows) was used to investigate the underlying structure of the relationships among the variables. The term “structural” indicates that it is assumed that the parameters are not just descriptive measures of association, but rather that they reveal a certain kind of “causal” relation[25]. If an earlier level of a predictor variable is associated with a later variable, we have evidence to infer that the predictor variable is associated with a later variable[26], either directly or indirectly. In the hypothetical model (Figure 4.3), SES in 2001 as the exogenous variable was predictive of physical health, LTC, and HALE, and physical health measured in the 2001 survey had an effect on the corresponding variable measured in 2004. Estimation of the best-fitting model was carried out by the method of maximum likelihood. The optimization algorithm was implemented with no-missing data parameters. In addition, the direct, indirect, and total effects of each latent variable on the endogenous variable were determined by subject gender. Group comparison analysis was done to examine gender differences/similarities in the measurement and structural relationships. The statistics used for goodness of fit were CMIN (χ^2), Normalized Fit Index (NFI), Comparative Fit Index (CFI), Incremental Fit Index (IFI), and root mean square error of approximation (RMSEA). A model was considered to have a good fit when the NFI, CFI and IFI were > 0.90, and the RMSEA was < 0.05. A p value below 0.05 was considered to be statistically significant.

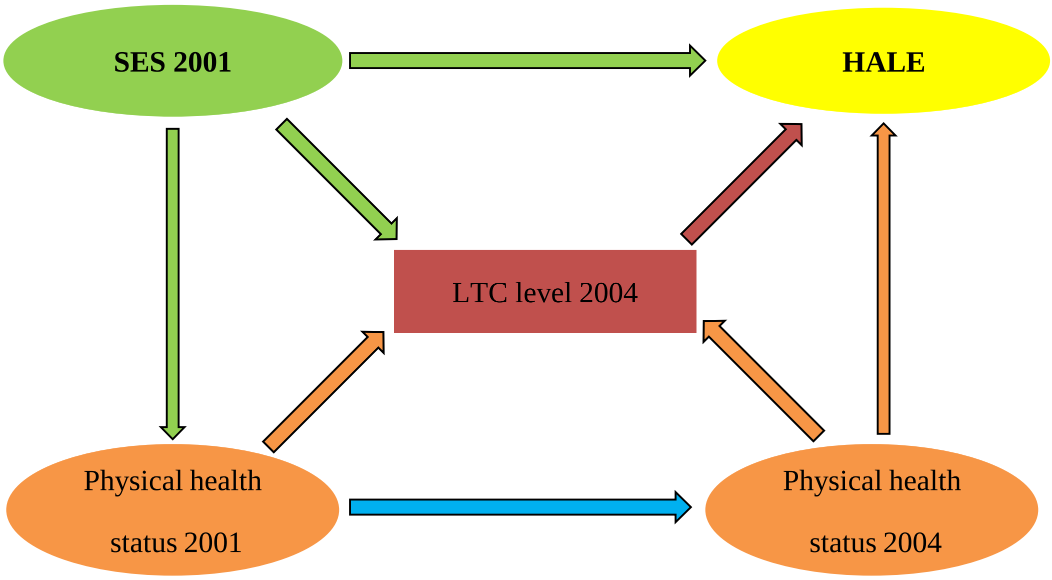


Figure 4.3: Hypothetical model — structural relationships between SES, physical health, LTC level and HALE.

4.2.5 Ethical Approval

All participants provided written informed consent forms along with their mailed-in questionnaires in both 2001 and 2004. The study authors signed an agreement with municipal authorities in which they pledged to protect the confidentiality of the participants' personal information. In addition, the study protocol was approved by the Ethics Committee of Tokyo Metropolitan University, Japan.

4.3 Results

4.3.1 Descriptive Analysis Results

The total number of participants was 7,905, which consisted of 3,754 men and 4,151 women, with a mean survival time of 1037.45 days from 2004 to 2007. Descriptive statistics indicated that all observed variables were distributed significantly differently by gender and age (Table 4.3). Most of the elderly received lower scores on all domains of BADL, IADL, comorbidity and LTC level, indicating they could take care of themselves independently. Approximately four-fifths of all elderly individuals rated their health as good and very good in 2004, whereas more women rated their health as fair and poor compared to men. More men than women reported annual incomes greater than 7 million yen and education levels beyond junior college for both young-old and old-old groups. The differences by gender of all variables were statistically significant ($p < 0.01$), and all age differences for both men and women were also statistically significant ($p < 0.05$), except the age difference of BADL score in 2001 for elderly men ($p = 0.82$).

Table 4.4 shows gender-specific variables and survival status at the end of the follow-up period of 3 years. During this period, 278 men and 160 women died. Crude mortality rates were 7.4% and 3.9%, respectively. Of those that passed away, a higher percentage were of older age, had higher disability and comorbidity scores, higher LTC levels, poorer SRH, lower income, and lower educational level.

The study sample was split into 7,366 of those in the no-LTC needs group and 539 of those in the LTC needs group in 2004 (Table 4.5). In the LTC needs group, there were nearly twice as many old-old women (n = 208) and old-old men (n = 90). Moreover, there were nearly twice as many old-old group (61.5%) as young-old (38.5%) in the no-LTC group. Compared to the no-LTC needs group, the elderly in the LTC needs group had higher scores of disability and comorbidity in both 2001 and 2004, and poorer SRH. The elderly in the no-LTC needs group had attained higher educational levels and earned much more money in 2001 than those in the LTC needs group. In the no-LTC needs group, the significant differences found by gender were that 60.3% of the men earned an annual income of more than 3 million yen, and 39.5% of the men got a diploma from at least a junior college, while only 37.5% of the women earned an annual income of more than 3 million yen, and 5.7% of the women got a diploma from at least a junior college. The significant gender differences were also found in the LTC needs group: men graduated from junior high school or lower with 32.3%, while 60.1% of women responded likewise.

Table 4.6 shows the distribution of physical health status by gender in 2001 and 2004. In terms of the BADL score, the proportion of elderly individuals who scored 0 had decreased by 6.0% for men and 13.6% for women, while the proportions of other scores increased for both men and women, indicating more elderly individuals need support in their daily activities. In terms of IADL score in 2004, the proportion of elderly individuals who scored 0 had decreased by 6.9% for elderly men and 8.7% for elderly women, while the proportions of other scores increased. The results indicated that elderly women were more likely than elderly men to experience physical activity limitation. In 2001, 71.2% of men and 78.1% of women did not have any diseases under treatment, and the proportion had decreased to 66.1% and 75.9%, respectively, in 2004. The number of elderly individuals who had at least one disease increased significantly from 2001 to 2004 ($p < 0.001$), and the changes for men were wider than for women.

Table 4.7.1 and 4.7.2 show the correlation analysis results for each variable in men and women. For elderly men, the educational level did not show significant relationships with comorbidity in both 2001 and 2004, and LTC in 2004, while annual income level did not show a significant relationship with BADL score in 2001 (Table 4.7.1). However, for elderly women, educational level and income level in 2001 showed slightly significant relationships with all observed variables ($p < 0.01$ or $p < 0.05$) (Table 4.7.2). For both genders, other observed variables showed significant and strong correlations. Educational level and annual income level were found to be positive with SRH in 2004, while BADL score, IADL score, comorbidity and LTC in 2004 showed negative and stronger correlation ($r < -0.30$, $p < 0.01$) with SRH in 2004.

Table 4.3: Distribution of observed variables by gender and age.

Variables	Men (n = 3,754)					Women (n = 4,151)					*p* -value
	young-old		old-old		*p* -value	young-old		old-old		*p* -value	
	n	%	n	%		n	%	n	%		
BADL score 2001											
0	2,603	90.1	777	89.7		2,559	87.8	1,053	85.3		
1	205	7.1	53	6.1		284	9.7	131	10.6		
2	5	0.2	5	0.6	p = 0.82	7	0.2	7	0.6	p < 0.05	p < 0.001
3	10	0.3	5	0.6		5	0.2	13	1.1		
missing	65	2.3	26	3.0		61	2.1	31	2.5		
IADL score 2001											
0	2,439	84.5	632	73.0		2,634	90.3	931	75.4		
1	267	9.2	123	14.2		118	4.0	104	8.4		
2	49	1.7	23	2.7		37	1.3	46	3.7		
3	37	1.3	17	2.0	p < 0.001	27	0.9	29	2.3	p < 0.001	p < 0.001
4	22	0.8	14	1.6		18	0.6	39	3.2		
5	26	0.9	14	1.6		13	0.4	32	2.6		
missing	48	1.7	43	5.0		69	2.4	54	4.4		
Comorbidity 2001											
0	2,089	72.3	582	67.2		2,355	80.8	889	72.0		
1	676	23.4	244	28.2		504	17.3	289	23.4		
2	107	3.7	36	4.2	p < 0.01	53	1.8	54	4.4	p < 0.001	p < 0.001
3	15	0.5	4	0.5		4	0.1	2	0.2		
4	1	0.0	0	0.0		0	0.0	1	0.1		
BADL score 2004											
0	2,533	87.7	620	71.6		2,344	80.4	703	56.9		
1	191	6.6	142	16.4		361	12.4	309	25.0		
2	28	1.0	24	2.8	p < 0.001	33	1.1	55	4.5	p < 0.001	p < 0.001
3	24	0.8	16	1.8		16	0.5	31	2.5		
missing	112	3.9	64	7.4		162	5.6	137	11.1		
IADL score 2004											
0	2,269	78.6	541	62.5		2,438	83.6	768	62.2		
1	290	10.0	113	13.0		167	5.7	98	7.9		
2	67	2.3	38	4.4		59	2.0	65	5.3		
3	39	1.4	23	2.7	p < 0.05	30	1.0	44	3.6	p < 0.001	p < 0.01
4	35	1.2	32	3.7		30	1.0	44	3.6		
5	35	1.2	26	3.0		28	1.0	66	5.3		
missing	153	5.3	93	10.7		164	5.6	150	12.1		
Comorbidity 2004											
0	1,936	67.0	544	62.8		2,294	78.7	856	69.3		
1	773	26.8	265	30.6		531	18.2	318	25.7		
2	157	5.4	51	5.9	p < 0.001	86	2.9	56	4.5	p < 0.001	p < 0.001
3	21	0.7	6	0.7		5	0.2	5	0.4		
4	1	0.0	0	0.0		0	0.0	0	0.0		
LTC level 2004											
0	2,777	96.2	776	89.6		2,786	95.5	1,027	83.2		
1	12	0.4	12	1.4		29	1.0	39	3.2		
2	36	1.2	37	4.3		60	2.1	99	8.0		
3	30	1.0	20	2.3	p < 0.001	17	0.6	22	1.8	p < 0.001	p < 0.001
4	11	0.4	6	0.7		10	0.3	20	1.6		
5	10	0.3	3	0.3		12	0.4	15	1.2		
6	12	0.4	12	1.4		2	0.1	13	1.1		
SRH 2004											
poor	159	5.5	68	7.9		163	5.6	109	8.8		
fair	307	10.6	139	16.1		400	13.7	219	17.7		
good	1,613	55.9	428	49.4	p < 0.001	1,667	57.2	658	53.3	p < 0.001	p < 0.001
very good	760	26.3	199	23.0		634	21.7	215	17.4		
missing	49	1.7	32	3.7		52	1.8	34	2.8		
Annual income 2001											
< 1 million yen	51	1.8	26	3.0		218	7.5	182	14.7		
< 3 million yen	874	30.3	278	32.1		1,066	36.6	532	43.1		
< 7 million yen	1,403	48.6	429	49.5	p < 0.001	1,064	36.5	235	19.0	p < 0.001	p < 0.001
> 7 million yen	339	11.7	52	6.0		181	6.2	34	2.8		
missing	221	7.7	81	9.4		387	13.3	252	20.4		
Educational level 2001											
junior high school	517	17.9	367	42.4		1,096	37.6	868	70.3		
high school	983	34.0	185	21.4	p < 0.001	1,412	48.4	187	15.1	p < 0.001	p < 0.001
junior college or higher	1,233	42.7	241	27.8		202	6.9	32	2.6		
missing	155	5.4	73	8.4		206	7.1	148	12.0		

Table 4.4: Distribution of observed variables and survival status by gender.

Vaiables	Men (n = 3,754)		Women (n = 4,151)		Total (n = 7,905)		*p*-value
	n	% of deceased	n	% of deceased	n	% of deceased	
Age 2001 (years)							
young old	2,888	5.3	2,916	2.3	5,804	3.8	p < 0.001
old-old	866	14.4	1,235	7.4	2,101	10.3	
BADL score 2001							
0	3,380	7.1	3,612	3.3	6,992	5.2	
1	258	6.2	415	7.2	673	6.8	p < 0.001
2	10	30.0	14	14.3	24	20.8	
3	15	46.7	18	27.8	33	36.4	
missing	91	12.1	92	2.2	183	7.1	
IADL score 2001							
0	3,071	6.0	3,565	3.2	6,636	4.5	
1	390	10.0	222	6.3	612	8.7	
2	72	16.7	83	8.4	155	12.3	
3	54	22.2	56	5.4	110	13.6	p < 0.001
4	36	19.4	57	7.0	93	11.8	
5	40	32.5	45	28.9	85	30.6	
missing	91	13.2	123	4.9	214	8.4	
Comorbidity 2001							
0	2,671	5.9	3,244	3.2	5,915	4.4	
1	920	10.9	793	5.3	1,713	8.3	p < 0.001
2	143	13.3	107	12.1	250	12.8	
3	19	10.5	6	16.7	25	12.0	
4	1	0.0	1	0.0	2	0.0	
BADL score 2004							
0	3,153	4.9	3,047	2.2	6,200	3.6	
1	333	17.1	670	6.7	1,003	10.2	p < 0.001
2	52	28.8	88	17.0	140	21.4	
3	40	47.5	47	31.9	87	39.1	
missing	176	18.2	299	6.0	475	10.5	
IADL score 2004							
0	2,810	5.1	3,206	2.2	6,016	3.6	
1	403	6.5	265	5.7	668	6.1	
2	105	16.2	124	7.3	229	11.4	p < 0.001
3	62	24.2	74	12.2	136	17.6	
4	67	32.8	74	13.5	141	22.7	
5	61	36.1	94	23.4	155	28.4	
missing	246	13.4	314	7.6	560	10.2	
Comorbidity 2004							
0	2,480	5.4	3,150	3.2	5,630	4.2	
1	1,038	9.9	849	4.6	1,887	7.5	p < 0.001
2	208	16.8	142	12.7	350	15.1	
3	27	14.8	10	20.0	37	16.2	
4	1	100.0	0	0.0	1	100.0	
LTC level 2004							
0	3,553	6.2	3,813	3.0	7366	4.5	
1	24	20.8	68	14.7	92	16.3	
2	73	23.3	159	6.3	232	11.6	p < 0.001
3	50	32.0	39	7.7	89	21.3	
4	17	23.5	30	30.0	47	27.7	
5	13	38.5	27	40.7	40	40.0	
6	24	41.7	15	26.7	39	35.9	
SRH 2004							
poor	227	31.3	272	18.4	499	24.2	
fair	446	14.1	619	4.7	1,065	8.6	p < 0.001
good	2,041	4.9	2,325	2.5	4,366	3.6	
very good	959	3.1	849	1.9	1,808	2.5	
missing	81	16.0	86	9.3	167	12.6	
Annual income 2001							
< 1 million yen	77	7.8	400	4.3	477	4.8	
< 3 million yen	1,152	8.2	1,598	4.2	2,750	5.9	p < 0.001
< 7 million yen	1,832	7.0	1,299	2.5	3,131	5.1	
> 7 million yen	391	4.3	215	0.5	606	3.0	
missing	302	10.9	639	6.6	941	8.0	
Educational level 2001							
junior high school	884	10.6	1,964	4.9	2,848	6.7	
high school	1,168	5.9	1,599	2.4	2,767	3.9	p < 0.001
junior college or higher	1,474	5.8	234	0.4	1,708	5.1	
missing	228	12.7	354	6.8	582	9.1	

Table 4.5: Descriptive characteristics of subjects by gender and LTC needs.

Variables	Men (n = 3,754)					Women (n = 4,151)				
	No-LTC need		LTC need		*p*-value	No-LTC need		LTC need		*p*-value
	n	%	n	%		n	%	n	%	
Age 2001 (years)										
young old	2,777	78.2	111	55.2	p < 0.001	2,786	73.1	130	38.5	p < 0.001
old-old	776	21.8	90	44.8		1,027	26.9	208	61.5	
BADL score 2001										
0	3,246	91.4	134	66.7		3,372	88.4	240	71.0	
1	223	6.3	35	17.4		355	9.3	60	17.8	
2	3	0.1	7	3.5	p < 0.001	2	0.1	12	3.6	p < 0.001
3	0	0.0	15	7.5		4	0.1	14	4.1	
missing	81	2.3	10	5.0		80	2.1	12	3.6	
IADL score 2001										
0	3,001	84.5	70	34.8		3,418	89.6	147	43.5	
1	364	10.2	26	12.9		183	4.8	39	11.5	
2	60	1.7	12	6.0		55	1.4	28	8.3	
3	31	0.9	23	11.4	p < 0.001	24	0.6	32	9.5	p < 0.001
4	13	0.4	23	11.4		23	0.6	34	10.1	
5	11	0.3	29	14.4		10	0.3	35	10.4	
missing	73	2.1	18	9.0		100	2.6	23	6.8	
Comorbidity 2001										
0	2,573	72.4	98	48.8		3,050	80.0	194	57.4	
1	846	23.8	74	36.8		683	17.9	110	32.5	
2	118	3.3	25	12.4	p < 0.001	75	2.0	32	9.5	p < 0.001
3	15	0.4	4	2.0		4	0.1	2	0.6	
4	1	0.0	0	0.0		1	0.0	0	0.0	
BADL score 2004										
0	3,118	87.8	35	17.4		2,992	78.5	55	16.3	
1	278	7.8	55	27.4		532	14.0	138	40.8	
2	7	0.2	45	22.4	p < 0.001	22	0.6	66	19.5	p < 0.01
3	2	0.1	38	18.9		3	0.1	44	13.0	
missing	148	4.2	28	13.9		264	6.9	35	10.4	
IADL score 2004										
0	2,781	78.3	29	14.4		3,141	82.4	65	19.2	
1	388	10.9	15	7.5		236	6.2	29	8.6	
2	96	2.7	9	4.5		92	2.4	32	9.5	
3	35	1.0	27	13.4	p < 0.001	39	1.0	35	10.4	p < 0.01
4	26	0.7	41	20.4		22	0.6	52	15.4	
5	14	0.4	47	23.4		21	0.6	73	21.6	
missing	213	6.0	33	16.4		262	6.9	52	15.4	
Comorbidity 2004										
0	2,403	67.6	77	38.3		2,972	77.9	178	52.7	
1	955	26.9	83	41.3		733	19.2	116	34.3	
2	175	4.9	33	16.4	p < 0.001	105	2.8	37	10.9	p < 0.01
3	19	0.5	8	4.0		3	0.1	7	2.1	
4	1	0.0	0	0.0		0	0.0	0	0.0	
SRH 2004										
poor	149	4.2	78	38.8		166	4.4	106	31.4	
fair	402	11.3	44	21.9		509	13.3	110	32.5	
good	1,988	56.0	53	26.4	p < 0.001	2,228	58.4	97	28.7	p < 0.01
very good	951	26.8	8	4.0		835	21.9	14	4.1	
missing	63	1.8	18	9.0		75	2.0	11	3.3	
Annual income 2001										
< 1 million yen	72	2.0	5	2.5		347	9.1	53	15.7	
< 3 million yen	1,064	29.9	88	43.8		1,456	38.2	142	42.0	
< 7 million yen	1,759	49.5	73	36.3	p < 0.001	1,232	32.3	67	19.8	p < 0.001
> 7 million yen	382	10.8	9	4.5		200	5.2	15	4.4	
missing	276	7.8	26	12.9		578	15.2	61	18.0	
Educational level 2001										
junior high school	819	23.1	65	32.3		1,761	46.2	203	60.1	
high school	1,121	31.6	47	23.4	p < 0.01	1,523	39.9	76	22.5	p < 0.01
junior college or higher	1,403	39.5	71	35.3		218	5.7	16	4.7	
missing	210	5.9	18	9.0		311	8.2	43	12.7	

Table 4.6: Physical health status for subjects in 2001 and 2004 by gender.

Variable	Men (n = 3,754)				Women (n = 4,151)				*p* -value
	2001		2004		2001		2004		
	n	%	n	%	n	%	n	%	
BADL score									
0	3,380	90.0	3,153	84.0	3,612	87.0	3,047	73.4	1) p < 0.001
1	258	6.9	333	8.9	415	10.0	670	16.1	2) p < 0.001
2	10	0.3	52	1.4	14	0.3	88	2.1	3) p < 0.001
3	15	0.4	40	1.1	18	0.4	47	1.1	
missing	91	2.4	176	4.7	92	2.2	299	7.2	
IADL score									
0	3,071	81.8	2,810	74.9	3,565	85.9	3,206	77.2	1) p < 0.001
1	390	10.4	403	10.7	222	5.3	265	6.4	2) p < 0.001
2	72	1.9	105	2.8	83	2.0	124	3.0	3) p < 0.001
3	54	1.4	62	1.7	56	1.3	74	1.8	
4	36	1.0	67	1.8	57	1.4	74	1.8	
5	40	1.1	61	1.6	45	1.1	94	2.3	
missing	91	2.4	246	6.6	123	3.0	314	7.6	
Comorbidity									
0	2,671	71.2	2,480	66.1	3,244	78.1	3,150	75.9	1) p < 0.001
1	920	24.5	1,038	27.7	793	19.1	849	20.5	2) p < 0.001
2	143	3.8	208	5.5	107	2.6	142	3.4	3) p < 0.001
3	19	0.5	27	0.7	6	0.1	10	0.2	
4	1	0.0	1	0.0	1	0.0	—	—	

1) Calculated by comparing each variable for men in 2001 and 2004 using Paired-Wilcoxon signed rank test;

2) Calculated by comparing each variable for women in 2001 and 2004 using Paired-Wilcoxon signed rank test;

3) Calculated by comparing each variable for all subjects by gender using the χ^2-test.

Table 4.7.1: Correlations between observed variables for elderly men.

	Education level 2001	Income level 2001	BADL score 2001	IADL score 2001	Comorbidity 2001	BADL score 2004	IADL score 2004	Comorbidity 2004	LTC level 2004	SRH 2004
Education level 2001	1									
Income level 2001	.303**	1								
BADL score 2001	-.065**	-0.011	1							
IADL score 2001	-.075**	-.064**	.373**	1						
Comorbidity 2001	-0.017	-.052**	.042*	.164**	1					
BADL score 2004	-.063**	-.064**	.332**	.488**	.148**	1				
IADL score 2004	-.072**	-.066**	.281**	.694**	.164**	.664**	1			
Comorbidity 2004	-0.005	-.036*	.036*	.153**	.687**	.184**	.200**	1		
LTC level 2004	-0.01	-.059**	.390**	.512**	.137**	.706**	.636**	.163**	1	
SRH 2004	.082**	.097**	-.060**	-.255**	-.246**	-.390**	-.366**	-.280**	-.305**	1

*p < 0.05; **p < 0. 01

Table 4.7.2: Correlations between observed variables for elderly women.

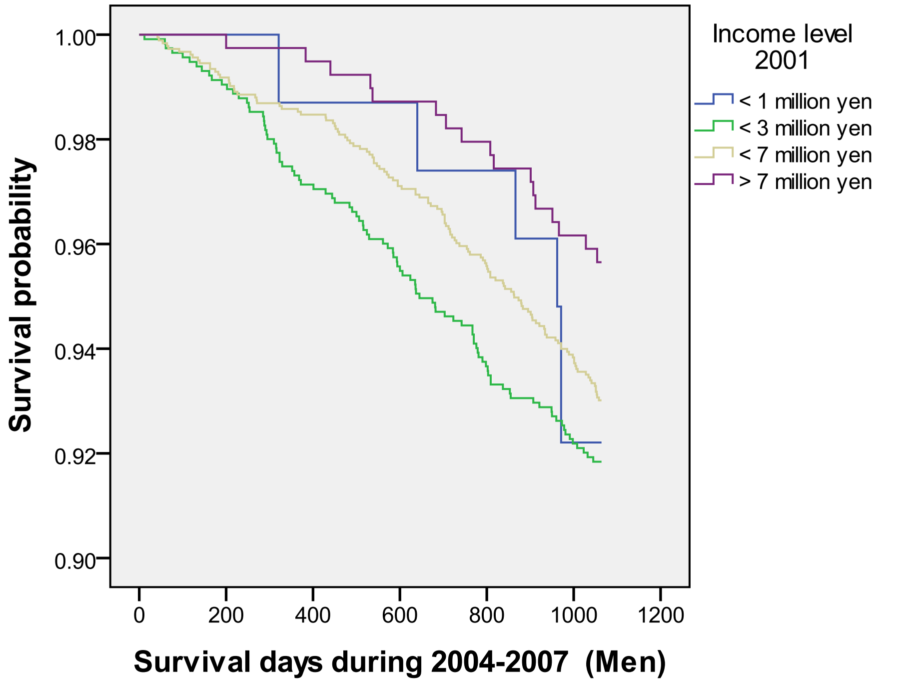
	Education level 2001	Income level 2001	BADL score 2001	IADL score 2001	Comorbidity 2001	BADL score 2004	IADL score 2004	Comorbidity 2004	LTC level 2004	SRH 2004
Education level 2001	1									
Income level 2001	.191**	1								
BADL score 2001	-.037*	-.035*	1							
IADL score 2001	-.124**	-.133**	.366**	1						
Comorbidity 2001	-.084**	-.065**	.089**	.202**	1					
BADL score 2004	-.120**	-.147**	.282**	.526**	.218**	1				
IADL score 2004	-.155**	-.151**	.241**	.716**	.177**	.666**	1			
Comorbidity 2004	-.077**	-.051**	.067**	.170**	.677**	.229**	.214**	1		
LTC level 2004	-.080**	-.092**	.283**	.547**	.168**	.654**	.679**	.218**	1	
SRH 2004	.077**	.079**	-.090**	-.279**	-.288**	-.423**	-.393**	-.311**	-.322**	1

*p < 0.05; **p < 0. 01

4.3.2 Survival Analysis Results

The estimated survival rates of all subjects during 2004-2007 were calculated by the Kaplan-Meier method. The differences between gender, age, BADL, IADL, comorbidity, and LTC needs were found to be significant by a log-rank test ($p < 0.001$). Elderly women were found to live longer than elderly men (96.1% versus 92.6%), and survival rates for the young-old and the old-old were found to be 96.2% and 89.7%, respectively. Survival rates decreased with higher scores in BADL, IADL, and comorbidity, in both 2001 and 2004. Survival rate difference between the LTC needs group and the no-LTC needs group was significant (95.5% versus 80.7%). Trends of increasing estimated survival rates with increased annual income level ($p < 0.01$) and educational level ($p < 0.001$) were observed among total elderly individuals. Figure 4.4.1 and Figure 4.4.2 show significant survival differences among different income and educational levels in 2001 by gender. The disparity of survival rate in annual income level was found to not be significant for men ($p = 0.08$). The survival curves for different LTC levels in 2004 by gender (Figure 4.4.3) indicated that, elderly women not only lived longer, but also showed a smaller gap between no-LTC needs and LTC needs compared with elderly men.

The observed variables were found to be significant in univariate Cox regression modeling for both men and women (Table 4.8), except the BADL in 2001 for men ($p = 0.18$) and annual income in 2001 for men ($p = 0.07$). Compared with the elderly who did not have BADL disability, IADL disability, and disease, the people who had disability and disease at different levels had a higher risk of death. LTC needs appeared to be most responsible for the observed survival differences, with a hazard ratio (LTC needs versus no-LTC needs) of 5.23 for men (95% CI: 3.91-7.00) and 4.99 for women (95% CI: 3.55-7.01). Compared with those who attained an education level of junior college or higher, those with a junior high education level or lower had 1.87 times of risk of death for men, and 11.70 times risk of death for women. Elderly women that earned 3 million yen or higher per year had 47% less risk of death compared to those earning less than 3 million yen per year.



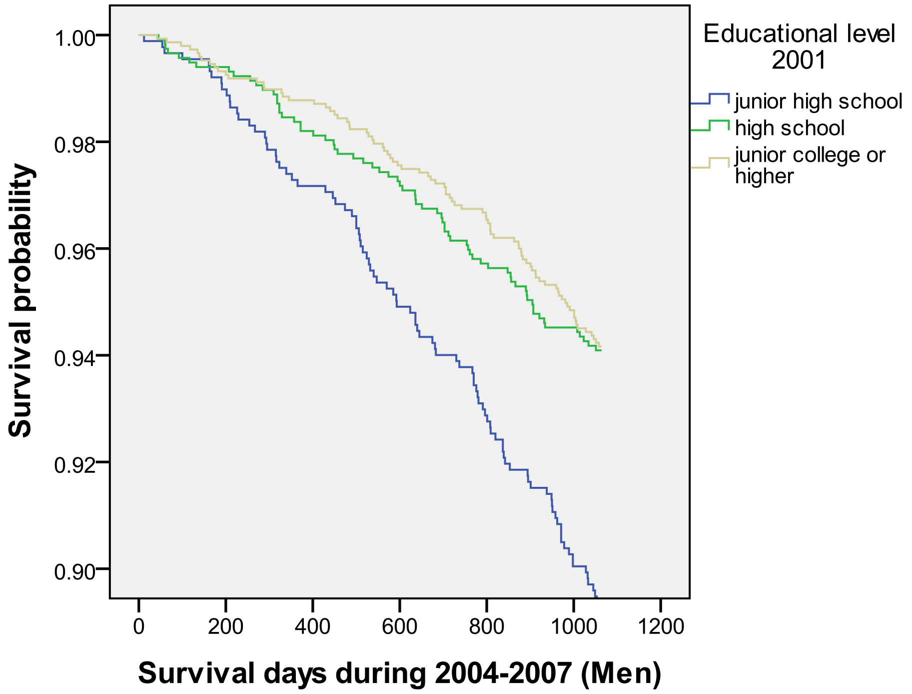
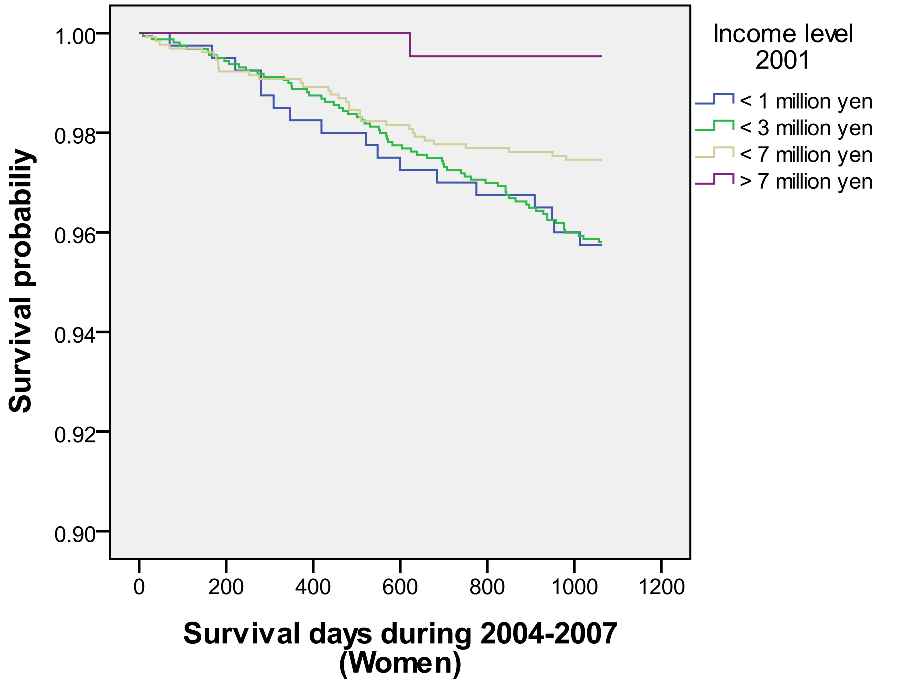


Figure 4.4.1: Kaplan-Meier survival curves according to income and educational levels in 2001 for men.



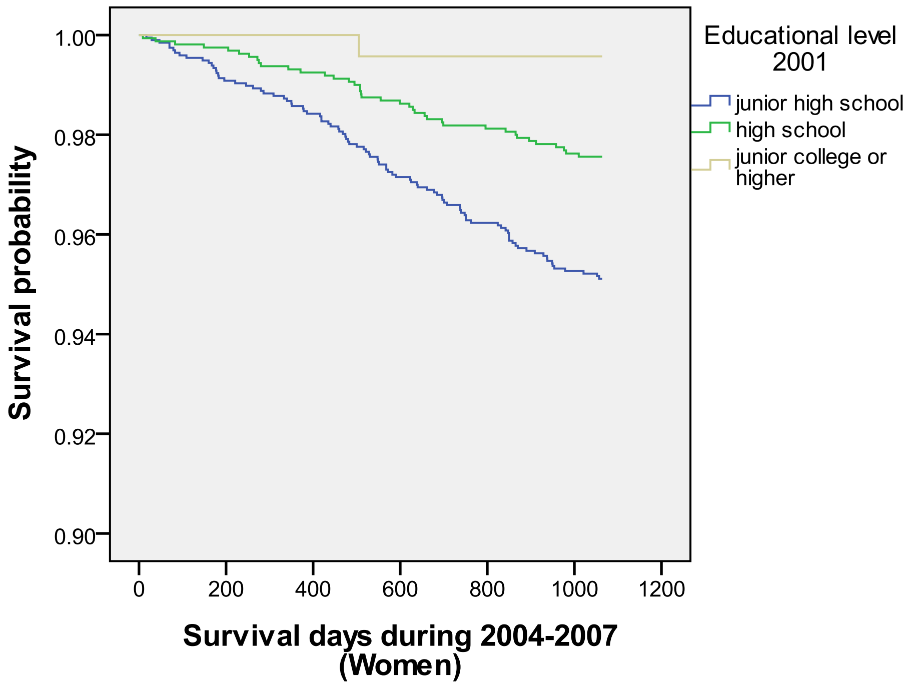


Figure 4.4.2: Kaplan-Meier survival curves according to income and educational levels in 2001 for women.

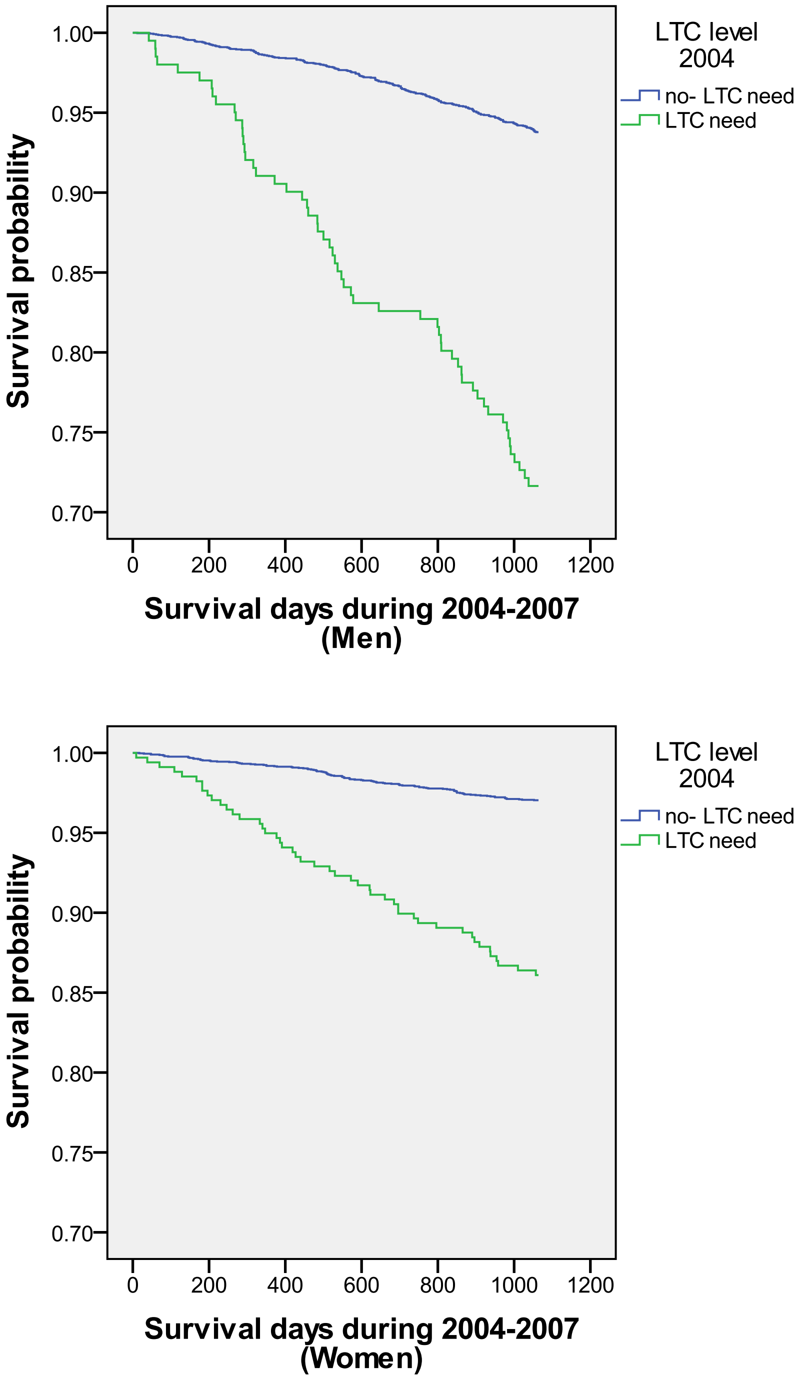


Figure 4.4.3: Kaplan-Meier survival curves according to LTC level in 2004 by gender.

Table 4.8: Independent association of each variable with mortality.

Predictor variable (reference category)	Category or range	Men		Women	
		Hazard ratio (95% CI)	*p* -value	Hazard ratio (95% CI)	*p* -value
BADL score 2001 (0)	1—3	1.32 (0.88–1.97)	p = 0.184	2.52 (1.74–3.64)	p < 0.001
IADL score 2001 (0)	1—5	2.46 (1.90−3.19)	p < 0.001	2.88 (2.01–4.12)	p < 0.001
Comorbidity 2001 (0)	1—4	1.96 (1.55–2.49)	p < 0.001	1.96 (1.41–2.70)	p < 0.001
BADL score 2004 (0)	1—3	4.80 (3.71–6.22)	p < 0.001	4.40 (3.17–6.12)	p < 0.001
IADL score 2004 (0)	1—5	3.06 (2.37–3.94)	p < 0.001	4.87 (3.48–6.82)	p < 0.001
Comorbidity 2004 (0)	1—4	2.12 (1.67–2.68)	p < 0.001	1.86 (1.35–2.57)	p < 0.001
LTC level 2004 (0)	1—6	5.23 (3.91–7.00)	p < 0.001	4.99 (3.55–7.01)	p < 0.001
Educational level 2001					
(3)	1&2	1.87 (1.40–2.51)	p < 0.001	11.70 (1.63–83.89)	p < 0.05
(2)	1&3	1.02 (0.74−1.40)	p = 0.915	5.76 (0.79–41.94)	p = 0.084
Annual income 2001 (< 3 million yen)	> 3 million yen	0.79 (0.61–1.02)	p = 0.069	0.53 (0.36–0.79)	p < 0.01

*Educational level in 2001 was entered as categorical variable. 1= junior high school or lower; 2= high school; 3= junior college or higher.

4.3.3 Factor Analysis Results

Factor analysis was performed on a data set of 11 observed variables. The SPSS software package used in this study included Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett’s test of sphericity to assess the adequacy of their correlation matrices for factor analysis. Table 4.9 shows that a KMO of 0.77 with significance supports a factor analysis of these variables. The factor loadings in the rotated component matrix (Table 4.10) showed that Factor 1 was characterized by LTC level in 2004, BADL score and IADL score, in both 2001 and 2004, Factor 2 by comorbidity in both 2001 and 2004, Factor 3 by annual income and educational level in 2001, and Factor 4 by survival days between 2004 and 2007 and SRH in 2004. They were defined as four latent variables: “disability in 2001 and 2004 and LTC level,” “comorbidity in 2001 and 2004,” “SES in 2001,” and “HALE.” The cumulative contribution proportion of the four latent variables was 67.87%.

Table 4.9: KMO and Bartlett's test result.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.771
Bartlett's Test of Sphericity	Approx. Chi-Square	20046.662
	df	55
	sig.	0.000

Table 4.10: Factor analysis results — rotated component matrix.

	Component			
	Factor 1	**Factor 2**	**Factor 3**	**Factor 4**
IADL score 2004	0.855	0.240	-0.155	-0.435
LTC level 2004	0.842	0.168	-0.096	-0.399
BADL score 2004	0.812	0.223	-0.177	-0.480
IADL score 2001	0.809	0.214	-0.120	-0.222
BADL score 2001	0.567	0.044	-0.025	0.099
Comorbidity 2004	0.197	0.912	-0.010	-0.199
Comorbidity 2001	0.178	0.910	-0.044	-0.162
Income level 2001	-0.103	-0.037	0.808	0.063
Educational level 2001	-0.096	-0.001	0.807	0.076
Survival days during 2004-2007	-0.214	-0.076	0.034	0.836
SRH 2004	-0.426	-0.427	0.177	0.620
Cumulative contribution %	32.61%	47.29%	58.78%	67.87%

Extraction Method: Principal component;

Rotation Method: Promax.

4.3.4 Structural Equation Modeling Analysis Results

In order to explore chronological relationships among corresponding variables in 2001 and 2004, and considering the causal effects of physical health on LTC level, we divided the two latent variables ("disability in 2001 and 2004 and LTC level" and "comorbidity in 2001 and 2004") based on the factor analysis results into two latent variables ("physical health status in 2001" and "physical health status in 2004") and one observed variable ("LTC level in 2004"). Four latent variables and one observed variable were then applied for SEM analyses.

Structural Equation Modeling by Gender

Firstly, separate models for all participants by gender were calculated. Figure 4.5.1 and Figure 4.5.2 represent the final models of the structural relationships of SES, physical health, LTC level, and HALE for men and women. The models fitted the data reasonably very well: although the χ^2 values were all statistically significant ($p < 0.001$) due to the large sample size, other indices showed a good fit (NFI = 0.949; CFI = 0.952; IFI = 0.952 and RMSEA = 0.046). HALE as an endogenous latent variable was found to be well-explained by SES in 2001, by physical health in both 2001 and 2004, and by LTC level in 2004 ($R^2 = 0.38$ for elderly men and $R^2 = 0.74$ for elderly women). These models describe path ways starting from SES in 2001 via physical health in both 2001 and 2004, and LTC level in 2004 leading to HALE. In addition, the paths from SES in 2001 via physical health in both 2001 and 2004 approached LTC level in 2004.

Standardized estimates of the effects of each variable on HALE are presented in Figure 4.6.1. Overall, SES in 2001 and LTC in 2004 predicted HALE strongly; LTC was the strongest determinant for men (-0.495), and SES was the strongest determinant for women (0.642). For both men and women, the indirect SES effects were slight, but the indirect effects of physical health in both 2001 and 2004 were stronger. In addition, significant predictive effects were observed from physical health in 2001 to the corresponding latent variable in 2004 (0.801 for men and 0.853 for women).

Figure 4.6.2 shows the standardized estimates of the SES effect on each variable except for HALE. SES was observed to be significantly and positively predictive of LTC level in 2004, and to be significantly and negatively predictive of physical health in 2001. In addition, SES indirectly affected physical health in 2004 and LTC level in 2004, and the indirect effects on LTC level in 2004 were stronger than its direct effect.

Compared with men, all standardized effects were much stronger on women. Regarding the gender differences by pairwise comparison, path coefficients from SES to HALE, LTC level in 2004, and physical health in 2001 were statistically significant at $p < 0.001$ (CR = 7.433, CR = 4.075 and CR = -6.193). However, the path coefficient from LTC level to HALE showed no statistically significant difference by gender with CR = 1.310 < 1.96.

Structural Equation Modeling by Age

Separate models for all participants by four age groups were calculated (Figure 4.7.1, Figure 4.7.2, Figure 4.7.3 and Figure 4.7.4). The models fit the data reasonably well with NFI of 0.934, CFI of 0.940, IFI of 0.940, and RMSEA of 0.035. HALE as an endogenous latent variables was found to be well-explained by SES in 2001, by physical health in both 2001 and 2004, and by LTC level in 2004 ($R^2 = 0.34$ for 65-69 years old group, $R^2 = 0.32$ for 70-74 years old group, $R^2 = 0.43$ for 75-79 years old group, and $R^2 = 0.34$ for 80-84 years old group).

Standardized estimates of the different variables on HALE are presented in Figure 4.8.1. With increased age, the direct and positive effects of SES on HALE decreased, while the direct and negative effects of LTC on HALE increased. For the path coefficient from SES to HALE, statistical significances were found between 65-74 years group with 75-79 years group (CR = -2.859) and 65-74 years group with 80-84 years group (CR = -2.31); for the path coefficient from LTC to HALE, the statistical significances were found between each age group (CRs > 1.96). The indirect effects of physical health in both 2001 and 2004 on HALE were also increased in the advanced age group.

Figure 4.8.2 shows the findings of standardized estimates of the effect of SES on each variable except for HALE. SES was observed to be significantly and positively predictive of LTC level in 2004, and to be significantly and negatively predictive of physical health in 2001. In addition, the SES was found to affect physical health in 2004 and LTC level in 2004 indirectly, and the indirect effects on LTC level in 2004 were stronger than the direct effect. However, compared with each age group, the different

SES effects on disability and comorbidity in 2001 and LTC level in 2004 were not statistically significant, with all CRs < 1.96.

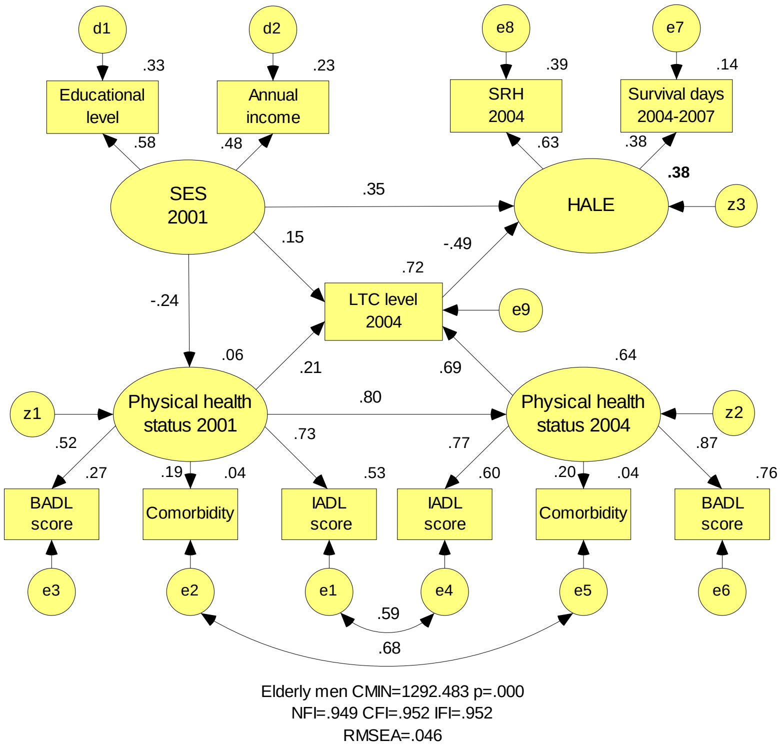


Figure 4.5.1: Structural relationships among HALE, SES, physical health, and LTC level for elderly men.

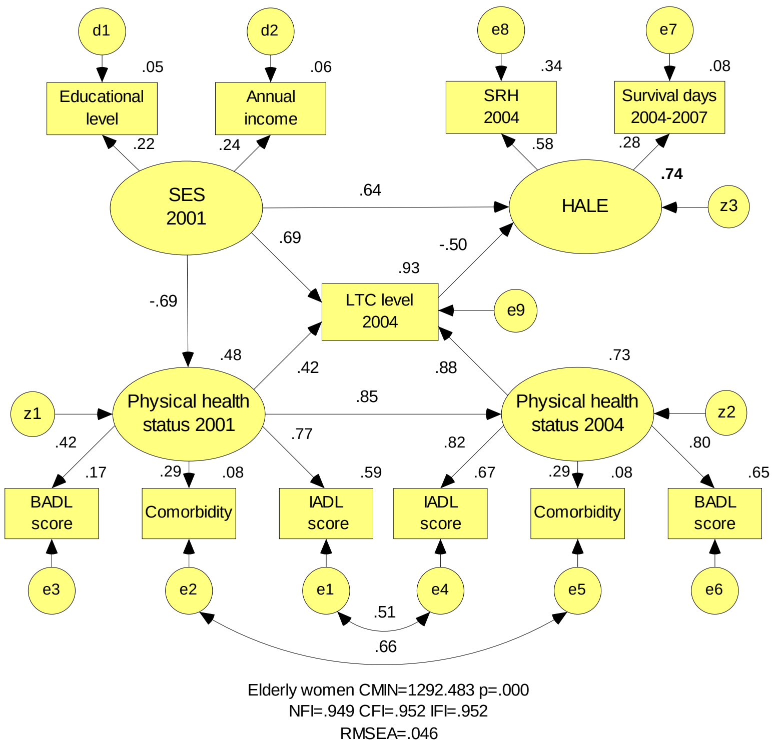
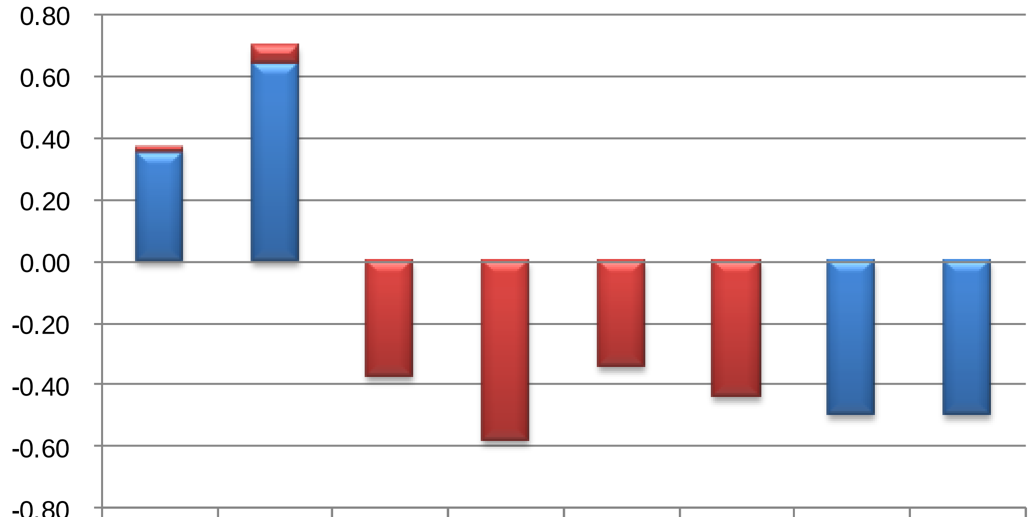
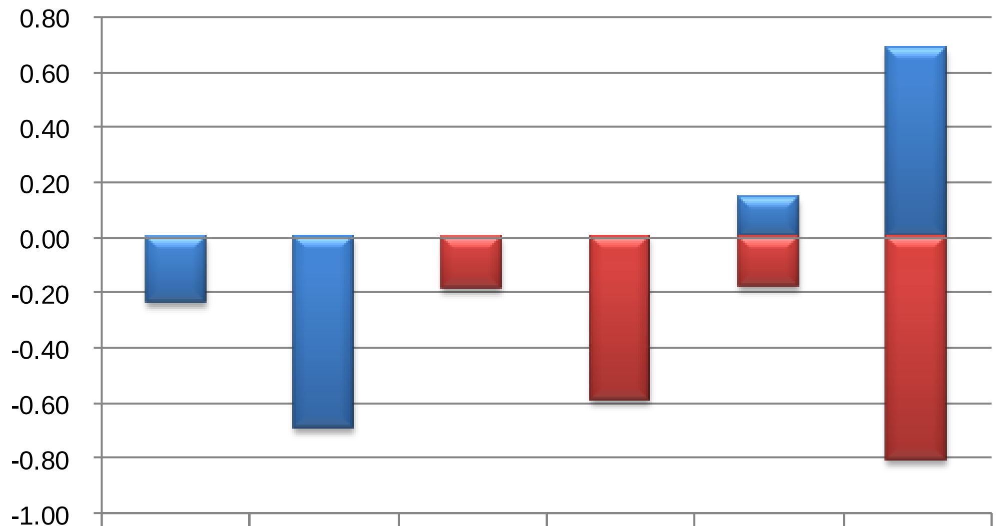


Figure 4.5.2: Structural relationships among HALE, SES, physical health, and LTC level for elderly women.



	SES		Physical health 2001		Physical health 2004		LTC level 2004	
	Men	Women	Men	Women	Men	Women	Men	Women
Indirect	0.016	0.059	-0.376	-0.584	-0.342	-0.440		
Direct	0.354	0.642					-0.495	-0.501

Figure 4.6.1: Standardized effects of SES, physical health, and LTC level on HALE by gender.



	Physical health 2001		Physical health 2004		LTC level 2004	
	Men	Women	Men	Women	Men	Women
Indirect			-0.188	-0.590	-0.179	-0.806
Direct	-0.235	-0.692			0.147	0.689

Figure 4.6.2: Standardized effects of SES on physical health and LTC level by gender.

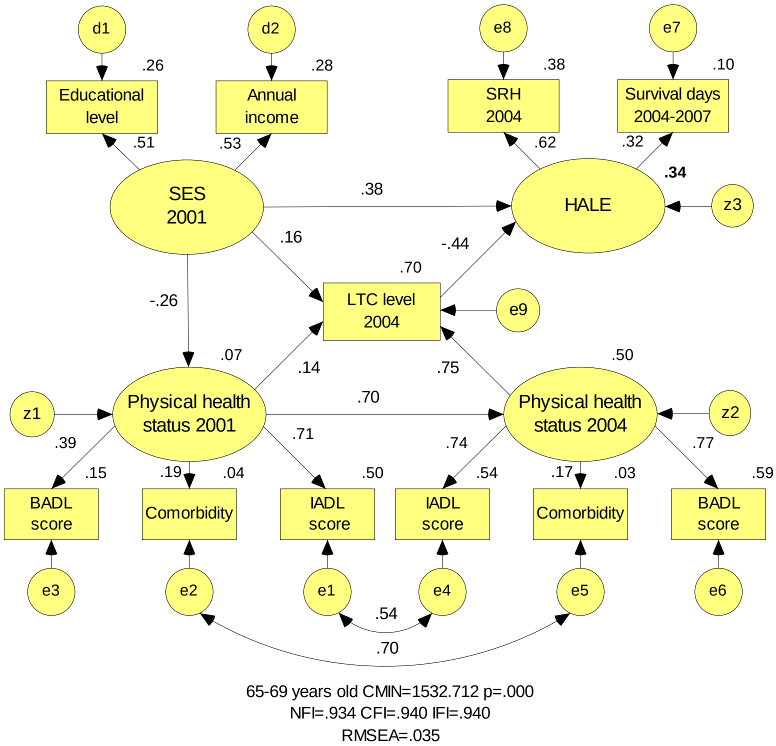


Figure 4.7.1: Structural relationships among HALE, SES, physical health, and LTC level for the 65-69 years old group.

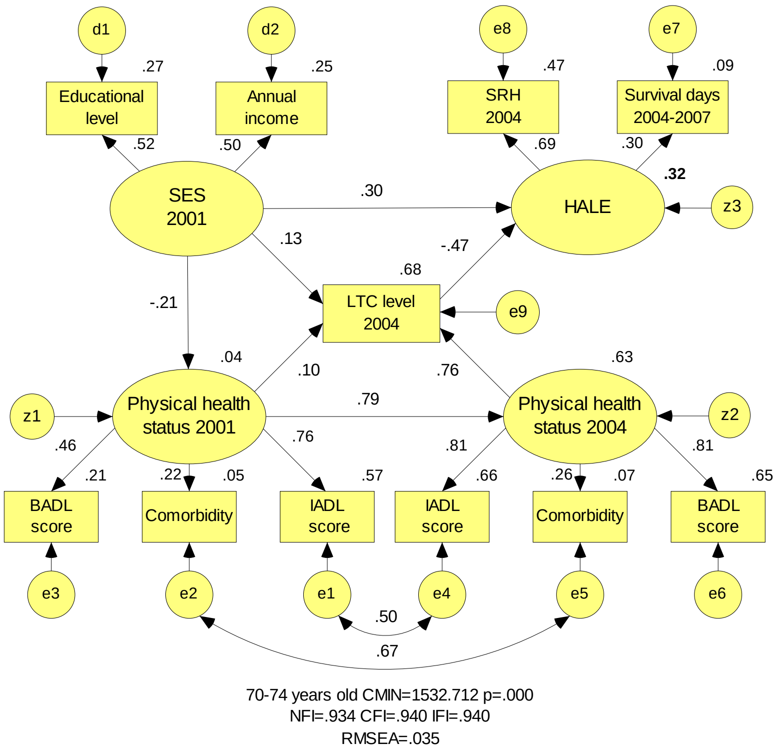


Figure 4.7.2: Structural relationships among HALE, SES, physical health, and LTC level for the 70-74 years old group.

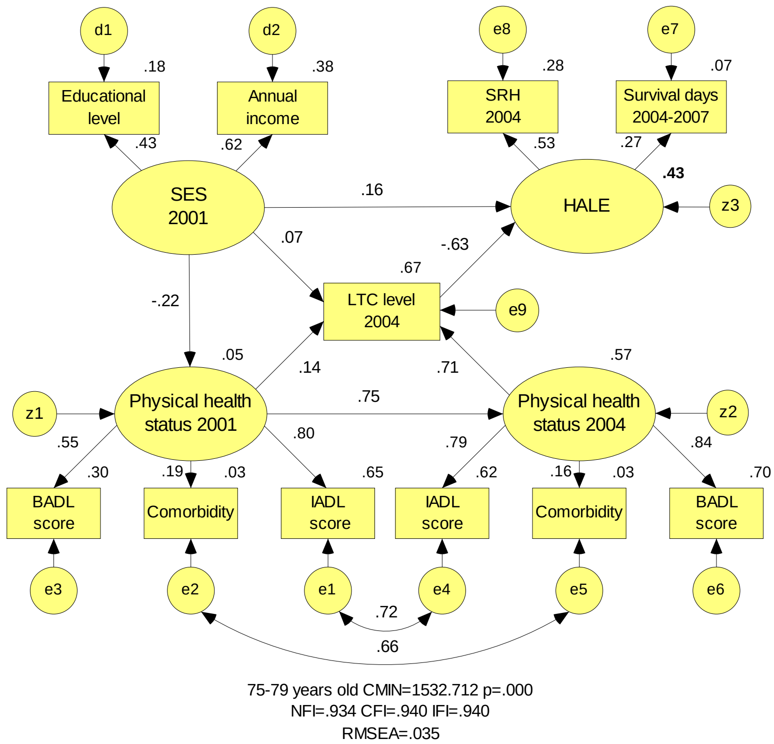


Figure 4.7.3: Structural relationships among HALE, SES, physical health, and LTC level for the 75-79 years old group.

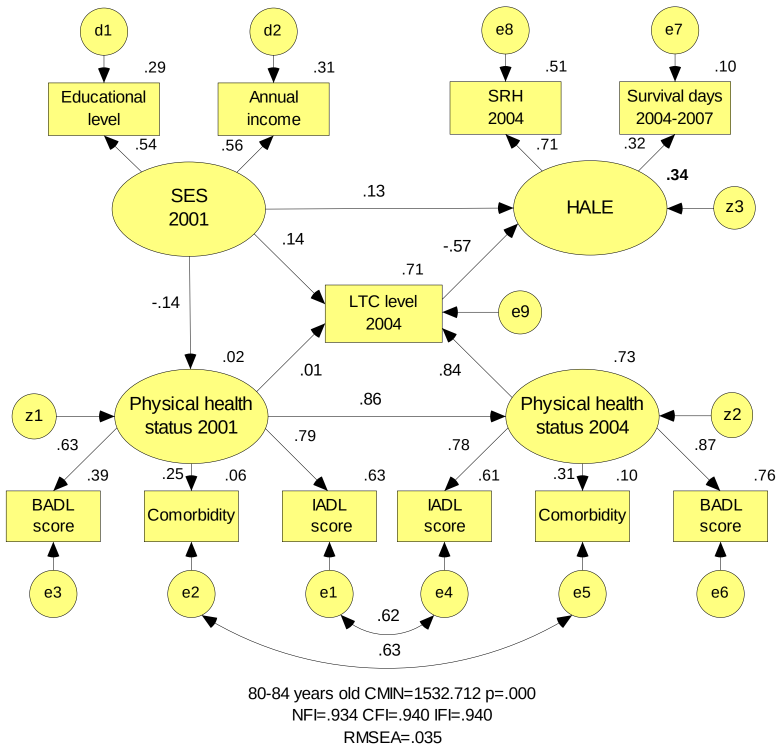
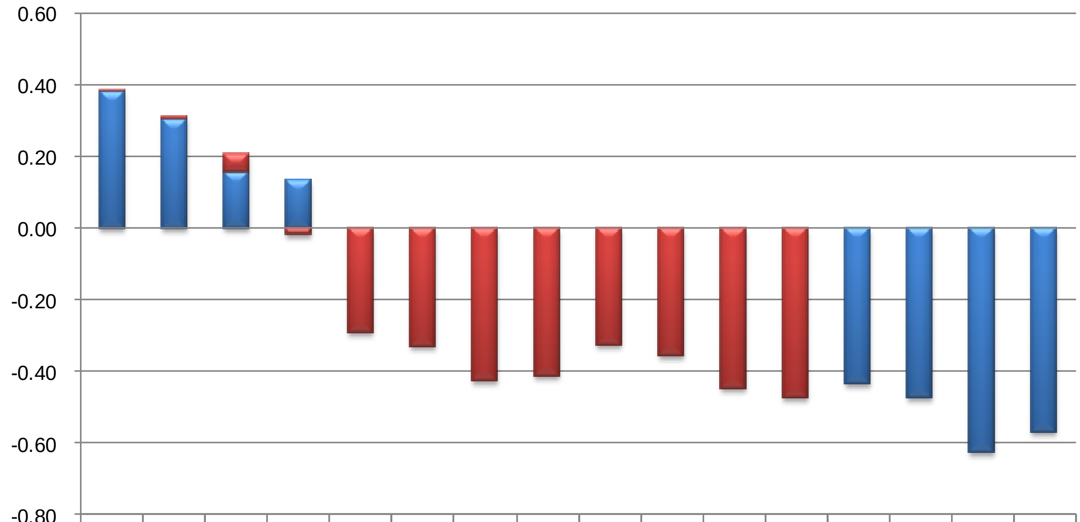
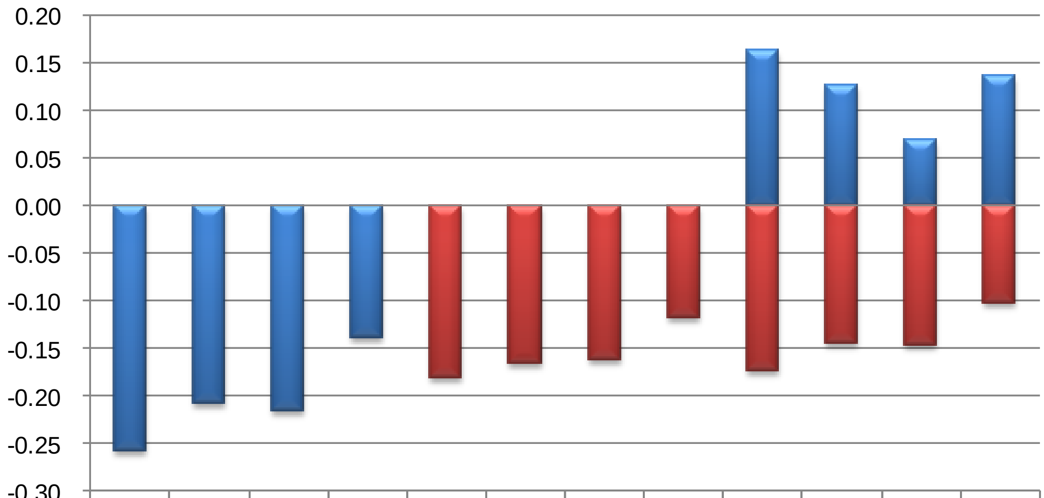


Figure 4.7.4: Structural relationships among HALE, SES, physical health, and LTC level for the 80-84 years old group.



	SES 65-69	SES 70-74	SES 75-79	SES 80-84	Physical health 2001 65-69	Physical health 2001 70-74	Physical health 2001 75-79	Physical health 2001 80-84	Physical health 2004 65-69	Physical health 2004 70-74	Physical health 2004 75-79	Physical health 2004 80-84	LTC level 2004 65-69	LTC level 2004 70-74	LTC level 2004 75-79	LTC level 2004 80-84
Indirect	0.005	0.009	0.049	-0.019	-0.292	-0.330	-0.426	-0.416	-0.328	-0.358	-0.447	-0.477				
Direct	0.380	0.304	0.156	0.135									-0.436	-0.473	-0.628	-0.570

Figure 4.8.1: Standardized effects of SES, physical health, and LTC level on HALE by four age groups.



	Physical health 2001 65-69	Physical health 2001 70-74	Physical health 2001 75-79	Physical health 2001 80-84	Physical health 2004 65-69	Physical health 2004 70-74	Physical health 2004 75-79	Physical health 2004 80-84	LTC level 2004 65-69	LTC level 2004 70-74	LTC level 2004 75-79	LTC level 2004 80-84
Indirect					-0.182	-0.166	-0.163	-0.119	-0.174	-0.146	-0.147	-0.102
Direct	-0.259	-0.209	-0.216	-0.139					0.163	0.126	0.069	0.136

Figure 4.8.2: Standardized effects of SES on physical health and LTC level by four age groups.

4.4 Discussions

The study found the causal mechanism of HALE with its related factors, including SES, physical health, and LTC level, of suburban elderly dwellers in Japan. SES was found to affect HALE directly and indirectly via physical health and LTC level. Among all variables, SES as the basic determinant was found to be the strong predictor of HALE with LTC. Significant gender and age disparities in the structural casual relationships were observed for each variable. Several distinguishing features of this study were: (1) a large sample size from a survey cohort tracked over six years; (2) specific and extensive indicators of HALE and LTC; and (3) gender and age comparisons.

In general, the impact of SES on HALE has been investigated among the elderly worldwide, and there appears to be a consistent inverse relationship between SES and HALE[27 – 29]. Previous studies demonstrated that there appears to be a consistent effect of SES on the length of the period of independence of elderly individuals[30]. In this study, SES was observed to be predictive of each variable; in particular, higher individual income and education level was observed to lead to less chronic diseases and better performance in daily activities, and would further lead to longer life expectancy of living with good health. The association between low SES and poorer survival also has been examined by different measures — for example, by education, occupation, housing tenure, income, poverty and composite measures[31]. Although the present study considered only two indicators of SES — educational level and annual income — it highlighted the association between SES and health outcome. Educational level as a stable indicator of SES has a cumulative effect across life, and results indicated that the hazard ratio for the elderly individuals with lower and middle educational levels, compared to the elderly with higher levels, was 1.33 (95% CI, 1.03-1.71). This agreed with the results from Fujino et al. [32], which suggested that individuals with low levels of education had an increased overall risk of death (16% and 26% increased risk for men and women, respectively). As for annual income, the elderly with lower educational levels had an increased overall death compared with those with higher levels, although it was not statistically significant for men. The association between SES and HALE might be a result of a mixture of biological, life-style behavioral, environmental, and social factors rather than one single cause. A previous study using the same database showed that SES had a significant and strong direct effect on healthy dietary and lifestyle habits, including smoking, drinking and diet[33], which might also affect some chronic diseases, particularly cardiovascular disease and cancers.

The results of this study verified a strong causal association between physical health and LTC level, so much so that they correspond quite well with actual situations. In Japan and most other developed countries, the demand for LTC services has been found to increase as the number of elderly people with disabilities or requiring support in their ADLs also increase[14, 34]. A chronological study in Japan showed that, from 1995-2004, the number of expected years with activity limitation at birth increased, and those years in persons with a limitation of some activities also increased[18]. The causal mechanisms for all participants revealed that three-year-prior physical health significantly predicted current corresponding variables. It is important to note that a deteriorating trend was found for physical functioning status among all subjects in this follow-up study. From 2001 to 2004, the percentage of the elderly population who scored 0 points for BADL disability decreased from 88.5 to 78.4%, the percentage who scored 0 points for IADL disability decreased from 83.9 to 76.1%, and the percentage who had no disease decreased from 74.8% to 71.2%. Regarding the comparison of BADL and IADL by gender, the decreases were more prominent in women than in men. Moreover, the standardized direct effects of physical health in both 2001 and 2004 on LTC level indicated that with improved physical functioning, the levels of LTC would be decreased. LTC level indicating the degree of physical disability and diseases, was found to predict mortality with hazard ratios of 4.65 (95% CI, 3.73-5.79). Therefore, in order to decrease LTC or support needs and expenditures in the future, it will be important to improve daily living capabilities and reduce the number of dependent elderly through better prevention. Prevention is important not only for averting cost-push pressure on health expenditures, but also for improving people’s HALE[35].

Gender disparities in SES in the present study showed that elderly women achieved a lower educational level and earned less annual income than elderly men. Although elderly women were found to live longer than men, they were more likely to experience activity limitation and need more support and care in their daily life. The causal mechanisms showed that the significant direct effects of SES on HALE, LTC level, and physical health were stronger for women than for men. However, the relationship between mortality and the education-income index was stronger for men than for women was revealed in another study[36]. There are several possible explanations for this result. One is that gender has been an important principle of stratification throughout Japanese: the dominant culture template for the role of Japanese women in society was that of a housewife and a *kyoiku mama* ("education mother") before World War II. Although women's status has since developed and improved, wide gaps of SES between males and females were shown to exist (Table 4.3). For this old generation, most of the elderly women had few educational opportunities and labor force participation. Because the question regarding income in the questionnaire included what the respondent's partner earns, elderly women who were married and did not work reported their husband's income as their own. The significant and strong relationship between SES and HALE of the elderly women showed that income and education gaps played a direct role in the HALE differences. Although the husband's income and education level are reasonably assumed as alternative measures of women's SES, other evaluation of income, such as equivalent income, and other SES indicators, such as job-type, should be applied in future work.

The decreased effect of SES on HALE with an increase in age was found in this study, which is in accordance with the convergence hypothesis about SES-Health at older ages. Representatives of the age-as leveler hypothesis suggest that health differentials by SES are largest in one's prime age and then converge at older ages due to a variety of factors[37–39]. As the models (Figures 7.1, 7.2, 7.3 and 7.4) showed, the direct effect of LTC level on HALE increased with an increase in age, but on the other hand, the indirect effects of physical health also increased at older ages. Although both SES and physical health status affected HALE of the elderly, the physical health decline of high SES ended up overriding the significance of SES.

Projections indicate that Japan will continue to be a rapidly aging society, with the proportion of population aged 65 years and older rising to 25% by 2015, making Japan the "oldest" country in the world[40]. A rapidly aging population as a result of improved survival also challenges the financing of, and quality of care in, Japan's health system[41].

This study has several implications: firstly, low educational level was found to lead to a significantly increased risk of death, even though the inequalities in Japan were relative lower than other developed countries. Social and political initiatives need to focus on the association between SES and health outcomes, through intervention at both individual and national level. Secondly, in the current study, improving physical functioning and the quality of LTC of the elderly were considered as the most important actions to improve their HALE.

4.5 Conclusions

In conclusion, this study revealed that elderly people with higher SES were more likely to live longer with good SRH, via living with lower LTC level, less chronic diseases, and better performance in daily activities, especially for elderly women. With an increase in age, a decline in physical health of high SES ended up overriding the significance of SES on HALE for the Japanese elderly. Future research should be done to assess more related factors with HALE and more comparisons between sub-groups, such as by location.

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Chapter 5

Conclusions and Implications

5.1 Framework of Dissertation

This doctoral dissertation is organized by five chapters.

Chapter 1 provided an introduction to five key concepts in the development of this dissertation: population aging, healthy life expectancy (HALE), socioeconomic status (SES), long-term care (LTC) level and physical health. Furthermore, the existing theories on population health status changes (“compression of morbidity”, “expansion of morbidity” and “dynamic equilibrium”) and the theoretical hypotheses about SES effects on HALE due to population aging (“status leveling hypothesis”, “cumulative advantage hypothesis” and “status maintenance hypothesis”) were discussed. Using findings from the literature, an international comparison, the trend over time, as well as gender and age differences were presented. Subsequently, the rationale, objectives, methods, and hypothetical model of the dissertation were addressed.

Chapter 2 presented an empirical study on “Prefectural mortality in relation to socioeconomic status and long-term care in Japan”. Prefectures in Japan were used as units of analysis and seven indicators were obtained from multiple data sources, which were published by government organizations and public institutions for years centering on 1995, 2000, and 2005.

Chapter 3 presented a follow-up study on “Healthy life expectancy in relation to socioeconomic status and physical health among Japanese elderly”. In all, 15,254 individuals aged 65-84 years in 16 municipalities from 10 prefectures in Japan were included for analysis.

Chapter 4 presented another follow-up study on “Healthy life expectancy in relation to socioeconomic status, physical health and long-term care levels among Japanese elderly”. The study objects were 7,905 respondents aged 65-84 years living in a suburban city of Tokyo. All individuals were followed from 2001 to 2007.

Chapter 5 summarized the most important findings and conclusions based on each study.

5.2 Main Conclusions

There were four main objectives of this study: describing the characteristics of SES and HALE of the Japanese elderly; exploring the associated factors with HALE, as well as investigating the direct and indirect effect of SES on physical health, LTC level and HALE; assessing the SES-HALE mechanism differences by gender, age and location; and shedding light on the need to review strategies for HALE improvement and LTC prevention.

The preceding chapters reported on the results of various analyses of large-scale data collected from 47 prefectures, 16 municipalities and a suburban city in Japan. The following are the results of each chapter:

In Chapter 2, a time trend analysis was applied to show SES, mortality and LTC variations among prefectures in Japan by using annual prefectural data. From 1995 to 2005, the average death rate of those aged 65 years and older, the rate of certification for LTC need, and the enrollment rate in higher education were found to be continuously increased; meanwhile, the age-adjusted death rate for male and female, prefectural per capita income and total employment rate were found to be continuously decreased. The variations of death rate of people age ≥ 65 years and per capita income continuously widened among the 47 prefectures. As a result of correlation analysis, a decreased mortality was found to be associated with a higher percentage of SES and a lower rate of certification for LTC. With respect to gender differences, male mortality was predicted by SES and LTC more strongly than female mortality. Based on linear regression analysis, the effect of SES on the death rate of the elderly became stronger and more significant in 2005. In conclusion, prefectures with higher socioeconomic levels and lower LTC application rates had lower death rates in males and elderly people in Japan.

Chapter 3 compared the correlation of SES, physical health and HALE of the elderly people in 16 municipalities in the follow-up study. SES was measured by individual income, HALE was measured by SRH and survival days, and physical health status was measured by four indicators — the degree of pain, comorbidity, IADL disability, and bedridden status. The results showed significant differences in the distribution of selected variables among subgroups by gender, age and geographic areas. Overall, factors related to two indicators of HALE (SRH and mortality) were slightly different. The degree of pain was associated with SRH but not with mortality: there were significant direct relationships between income level and mortality in the Cox regression models, but not with SRH in the structural equation models. Compared with elderly men, elderly women tended to experience more chronic illness, functional disability and worse SRH. Income differentials in mortality interacted with age and indicated that the convergence SES effect on health at older ages. Compared with the elderly living in villages and towns, the elderly living in cities had higher income, less pain, less disease, less physical disability, and better SRH. In conclusion, SES as the determinant of physical health and HALE: lower SES of the elderly was associated with an increase in mortality, directly, and a decrease in SRH, indirectly, via physical health status. The significant distributions of SES, physical health and HALE were found by gender, age and location among the elderly people in 16 municipalities of Japan.

Chapter 4 investigated the causal relationship of HALE with SES, physical health and LTC level of suburban elderly dwellers in Japan. Two indicators of SES in 2001 (educational level and annual income), two indicators of HALE (SRH in 2004 and survival days during 2004 and 2007), three indicators of physical health status in both 2001 and 2004 (BADL disability, IADL disability and comorbidity) and LTC level in 2004 were applied for data analysis. SES was found to affect HALE directly and also indirectly via disability and comorbidity and LTC level. Significant gender and age disparities in the structural relationships between HALE and its associated factors were observed for each variable. Although elderly women were found to live longer than men, they were more likely to experience activity limitation and need support in their daily life. Significant direct effects of SES on HALE were stronger for women compared to men. The decreased effect of SES on HALE with increasing age was shown in this study. In conclusion, the result revealed that elderly people with higher SES were more likely to live longer with good SRH, via living with lower LTC level, less chronic diseases and better performance in daily activities, especially for elderly women. With an increase in age, the physical health of those with high SES declined, which overrode the significance of SES on HALE for the Japanese suburban elderly.

5.3 Notable Findings

The distinguishing features of this study are:

(1) Comprehensive data for Japanese elderly were applied using a large sample size from two follow-up surveys (one survey followed for a duration of 1-2 years, and the another survey cohort tracked over six years), data were collected during 1995-2007, and the time trend was explored.

(2) Special and extensive indicators of SES and HALE were applied in each study.

(3) Gender, age and area comparisons were specified in each study.

The results of this study showed that in Japan, SES had both a direct and an indirect effect on HALE in the elderly, interacting with physical health status and LTC level. The notable findings are as followings, based on the verification of the hypothesis model (Figure 1.13):

(1) SES was observed to be directly predictive of HALE (Figure 5.1 and Figure 5.3); however, income level was observed to be associated with mortality directly, but not with SRH directly (Figure 5.2).

(2) SES was observed to be predictive of LTC level directly on both the prefectural level and the individual level (Figure 5.1 and Figure 5.3); however, the effects were not strong in general (standardized direct effects < 0.30), except for elderly women (standardized direct effects = 0.69).

(3) There was a consistent and strong relationship between SES and physical health (Figure 5.2 & Figure 5.3).

(4) A strong causal association between physical health and LTC level was verified on the individual level (Figure 5.3).

(5) SES was observed to be indirectly predictive of HALE via LTC level on the individual level, and LTC level was a strong predictor of HALE (Figure 5.1 and Figure 5.3).

(6) SES was not observed to be predictive of HALE indirectly via physical health on the individual level, but physical health status did affect HALE significantly (Figure 5.3); however, income levels were observed to be predictive of SRH indirectly via physical health status of the elderly (Figure 5.2).

(7) SES was observed to be indirectly predictive of HALE via both physical health and LTC level, because of the strong association between physical health and LTC level, and the association between LTC level and HALE (Figure 5.3).

(8) The distributions of SES, HALE, physical health status and LTC level by gender, age and location were found among the elderly people in Japan.

Firstly, our study revealed that the relationship between mortality and each of the SES indicators were stronger and more significant for men than for women at the prefectural level. However, the direct effects of individual SES on HALE were stronger for women than for men. This is possibly due to the SES measures in the different studies, as there were no associations between any of the three prefectural SES indictors (education, income and employment) with mortality for women (Figure 5.1). Furthermore, there were no significant differences by gender in the relationship between annual income and SRH (Figure 5.2). In reverse, if all indicators in a latent variable were combined and the indirect effects were considered, the gender difference in the relationship between SES and HALE were significant with a stronger effect for elderly women (Figure 5.3). Elderly Japanese women generally do not work, and rely on their husband’s income; thus, educational attainment is a reasonably better measure for the SES of elderly women.

Secondly, the SES differences in physical health and HALE interact with age; in particular, the effects become smaller at advanced age, or even diminish. However, the geographic differences of the SES effects on mortality and SRH of the elderly were observed on both a prefectural and individual level.

Thirdly, the inconclusive relation between health and geographic area characteristics has been elucidated. On the prefectural level, significant relationships between each of the SES indicators and mortality showed prefectures which had higher SES levels and lower LTC levels had lower death rate. On the individual level, the elderly living in cities had higher income, better physical health and SRH. The effects of physical health and annual income on mortality were stronger for the elderly living in cities compared to those living in villages and towns. However, there was no statistically significant difference in the structural relationships among SES, physical health and SRH. Thus, the location differences on the SES-HALE associations should be further explored.

Last but not least, it was found that the direct effect of SES on HALE becomes stronger with increased age for the elderly. The data of three studies were collected at different levels — 47 prefectures, 16 municipalities and one city. The measures of SES and HALE were different, but nevertheless, SES can be considered as a predictor of HALE of the elderly people in Japan.

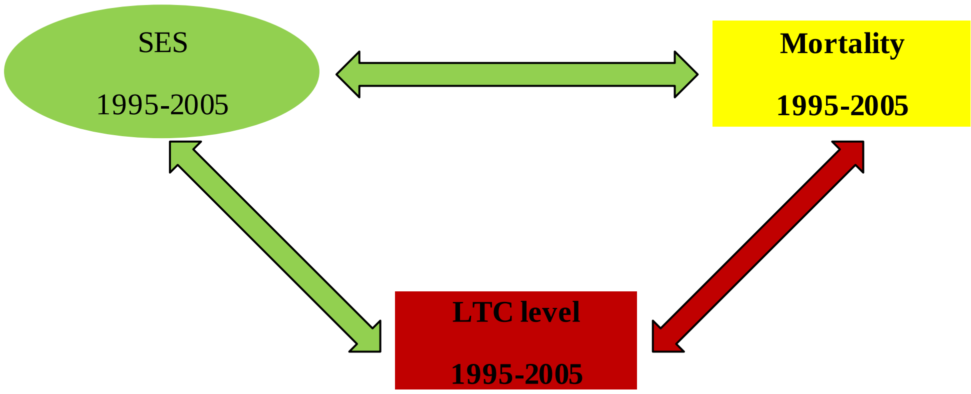

Figure 5.1: The correlations between SES, LTC and mortality in Japan.

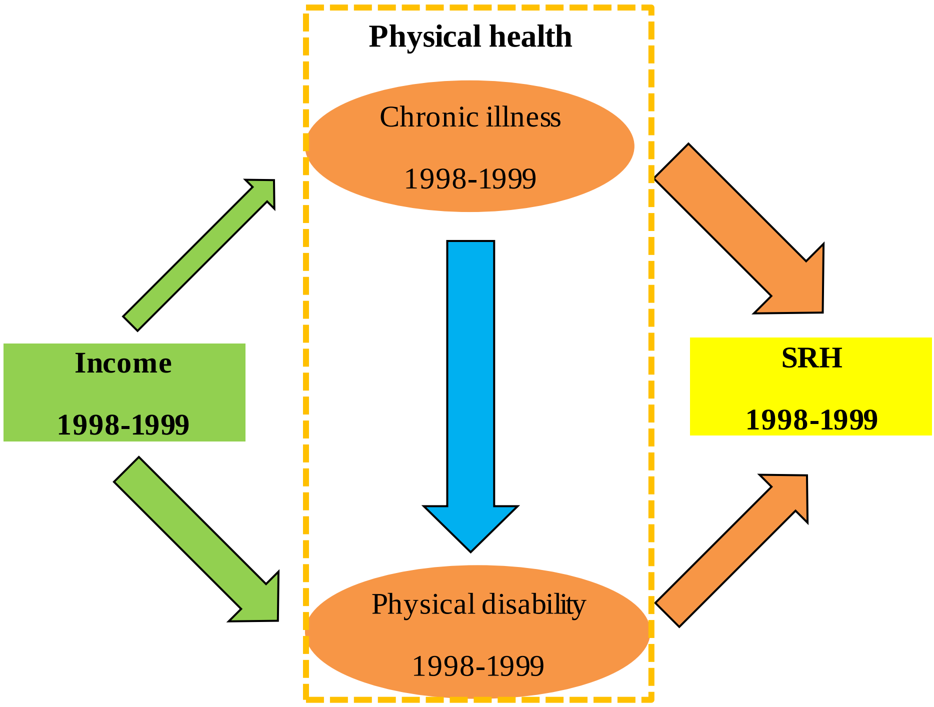

Figure 5.2: The structural relationships among annual income, physical health and SRH of the individual elderly in Japan.

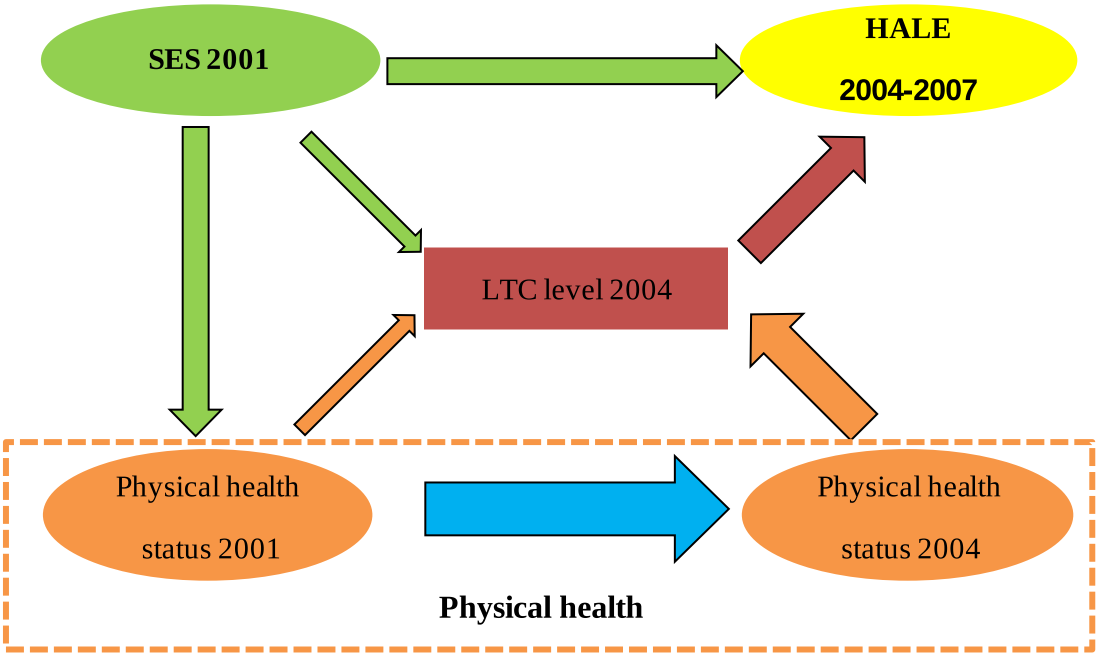

Figure 5.3: The structural relationships among SES, physical health, LTC level and HALE of the individual elderly in Japan.

5.4 Implications

Based on the conclusions shown in each chapter, it was concluded that overall, the results show that a deeper understanding and awareness of socioeconomic HALE determinants, including income, education and occupation, will contribute to the development of a multi-sectorial health policy which will improve the overall health of the elderly people in Japan. “Social disparities in health” were observed among the elderly people in Japan, which in the 1980s was regarded as one of the most egalitarian societies in the world. Considering the social determinants of health and its path ways, it would be sensible for policy makers to improve the elderly people’s income or career opportunity through intervention at both individual and national levels. Even if the education level cannot be changed for the elderly, policy makers can focus on devising prevention programs that are easily accessible by persons with less education and lower level of income.

SES had an indirect effect on HALE via physical health and LTC level; furthermore, disability amongst the elderly is the main factor driving the demand for LTC services. Thus, in order to decrease LTC needs and expenditures in the future, it will be important to improve daily living capabilities and reduce the number of dependent elderly through better prevention. Prevention will be helpful not only for improving people's quality of life, but also for decreasing their cost to society. A trend for deteriorating physical health status among all subjects was found in the study, and the significant and strong effect of SES on disability should be considered in planning intervention measures. To put it briefly, improving SES can reduce the LTC need via improving the physical health of the elderly at the source of the drain on LTC services.

Long-term care prevention policies might need to provide separate programs for men and women across different age groups. In Japan, elderly women attain lower educational levels and earn less than elderly men. Moreover, elderly women were more likely to experience activity limitations and required increased care due to their increased life expectancy compared to men. SES differences in HALE are greater in young-old elderly than in old-old elderly. Thus, prevention should pay more attention to the elderly women and the young-old elderly.

5.5 Limitations and Future Studies

In Japan's aging society, a rapid increase in the elderly population is inevitable. While HALE is a useful measure to assess overall heath, there are suggestions that the predictive value of HALE for mortality in elderly individuals may not be uniform across only one aspect of health status. Additional measures should be taken into consideration, such as mental health and social health, so that individuals can lead longer lives and experience a higher quality of life. In addition, future research may need to take into account the complexity of elderly people's situation, such as their living environment, marital status, life-style, and even just their age (for those older than 85). In other words, many different approaches with various factors and data analysis methods need to be combined to study elderly people with a higher level of external validity and reliability in the future. Finally, comparison studies should be conducted in other countries including developed countries and developing countries, in order to explore the SES effects on HALE of elderly people.

ACKNOWLEDGEMENTS

The completion of this dissertation has probably been the most challenging activity of my life. I knew that I had to finish my doctoral journey in my own time and on my own terms; however, I could not have succeeded without the support of several people to whom I am very grateful.

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Of course, I wish to thank my family: my parents, my brother and my fiancé for their endless and unequivocal support and sacrifice, which has made it possible for me to continue my studies. I sincerely thank my fiancé for his never-ending love, understanding and motivation.

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them good health and a long life. There are also many from behind the scenes who have encouraged and supported my work, and I wish to thank them too. Thank you all!

The best outcome from these past three years is finding a satisfactory job in Shandong Academy of Social Science in China, where I can continue to carry out aging-related research. My life journey will begin a new starting point after graduation. I wish I could have more opportunity for advancement in future!

Suwen Yang

2013.9

学 位 論 文 要 旨

論文題名

日本に居住する高齢者の健康寿命に影響する社会経済要因の効果

The Effect of Socioeconomic Status on Healthy Life Expectancy of the Elderly in Japan

（ふりがな）　　やん　すうぇん

学位申請者　楊　　素雯　　㊞

（ 学位論文要旨 ）

本論文の研究背景は、平均寿命の延伸と共に出生数が急激に低下し、少子高齢社会が急速に進み、要介護認定割合が増加している日本において、健康で長寿を全うすることは、本人だけではなく社会保障面からも意義が高いことである。本論文は、このような健康長寿社会を実現する上での個人レベルでの生活要因として、社会経済的要因、身体的健康度、要介護認定度などの位置づけと関連性を構造的に明確にすることを研究目的としている。

まず、健康寿命と関連する社会経済的要因や身体的精神的、そして社会的健康三要因に関する国内外の先行研究をレビューし、西欧諸国においては、社会経済学的要因と死亡率との間には負の関連が見られることを考察した。日本は、第二次世界大戦後の貧困時代を経て、その後の経済産業の発展に伴い、他国に比べて所得較差が少ない社会が実現できていた。また、健康水準を示す健康寿命と社会経済的要因との関連にはやや弱い関連が見られていたものの、経済的にみた不平等や所得較差が 1990 年代より拡大していることを明確にし、健康寿命延伸のための施策を立案する上で、社会経済的要因と健康寿命との因果構造を集団と個人レベルで明らか

にする必要性が高いことを明確にしている。

次に 1995 年から 2005 年までの 47 都道府県の平均寿命と要介護認定割合の変遷と社会経済学的要因との関連を多変量解析によって分析し、社会経済的要因である年間収入額や学歴が高い県ほど、平均寿命が長く、年齢調整死亡率が低く、要介護認定割合が統計学的に少ない関連を明らかにすると共に、このような関連は女性よりも男性において強いことを明確にしている。

さらに、全国 16 自治体に住む 60 歳以上高齢者、15,254 人を追跡したデータを分析し、主観的健康感や社会経済的要因が、その後の累積生存率と有意な関連がみられることを明確にしている。また、年間収入が、身体の痛みと治療中の疾病数を抑制し、最終的には主観的健康感を間接的に高める因果構造を明確にしている。またこのような関連構造は、自治体の人口区分別、性別、年齢階級別でも同様に示されることを明らかにしている。

また、都市郊外に住む高齢居住者における健康寿命を規定する因果構造を明確にすることを目的として、都市郊外居住高齢者を対象として、2001 年に 65 歳以上の 7,905 人に対し、2004 年と 2007 年に実施された追跡調査データを用いて分析した。その結果、社会経済的要因が健康寿命を延長させる構造は、日常生活能力を維持し、要介護認定度を予防することを経て、間接的に規定する因果構造を明確にしている。そしてこのような関連効果は、女性の方が強い関連が見られ、同時に加齢と共に社会経済的要因の寄与度が低下しやすいことを明らかにしている。

本研究の主要な成果としては、健康寿命を規定する社会経済的要因が直接的な効果を持つと共に、身体的な健康度や要介護状況を経由する間接効果も見られることを明確にしている点である。また社会経済的要因が健康度を規定する程度は、男性に比べて女性の方が強い関連が見られるものの、加齢と共に社会経済的要因の寄与度が低下しやすいことを明確にしている。要介護状況は、社会経済的要因を基盤

として、身体的健康度が維持されることを経由して予防される因果構造と共に、後期高齢者に比べて前期高齢者で強い関連が見られることを明確にしている。

このように、健康寿命と関連する要因の因果構造に関する科学的なエビデンスにより、高齢者の健康寿命を延伸させるための健康支援において、社会経済的要因の位置づけと意義が明確となったものである。今後の効果的な健康づくり施策においては、科学的なエビデンスを踏まえ、性別と共に、年齢特性に考慮し、特に介護予防では前期高齢者への対応が有効である可能性を提示している。

APPENDIX A:

Questionnaire for 16 municipalities

この調査票は、できるだけ、ご本人がお答えください。
ご本人がお答えできない場合はご家族の方が記入されても結構です。

1. この調査は誰が回答しましたか？

1. 本人
2. 本人以外の代理の方

2. ご本人がお答えできない理由をお選びください。

1. 痴呆・理解力なし　2. 多忙　3. 聴力障害
4. 視力障害　5. 言語障害　6. 拒否　7. 病気・けが
8. 不在　9. その他（　　　　　　　）

3. あなた（高齢者）ご自身のことについてお答え下さい。

年齢	満　　　歳	性別	1.男　2.女	電話	－

ここに住所タックシールを貼る

あなたのお体の状態についておたずねします。

問1 あなたが、最近、痛みを感じる所があれば、すべてに○をつけてください。

1. 腰　2. 膝　3. 腕　4. 足　5. 首　6. 肩　7. その他　8. ない

問2 あなたが、現在治療を受けている疾病がありますか？
あてはまるものすべてに○をつけてください。

1. 高血圧　2. 脳卒中（脳梗塞、脳出血、くも膜下出血など）
3. 糖尿病　4. 心臓病（心筋梗塞、狭心症、不整脈など）
5. 肝臓病　6. その他　7. ない

あなたの健康感についておたずねします。

問3	あなたは、普段ご自分で健康だと思いますか？（一つだけ選んでください。）

1. とても健康である
2. まあまあ健康である
3. あまり健康ではない
4. 健康でない

あなたの生活機能についておたずねします。

問4	あなたの日常の家事や行動範囲についてはいかがですか。 今のあなたの状態に最も近いものを一つだけ選んでください。 したことがなくても、たぶん出来ると思われる方は、はいとしてください。

① 自分で日用品の買い物ができますか？　1. はい　2. いいえ

② 自分で食事の用意ができますか？　1. はい　2. いいえ

③ 自分で預貯金の出し入れができますか？　1. はい　2. いいえ

④ 自分で年金や保険の書類が書けますか？　1. はい　2. いいえ

⑤ 新聞や書物を読んでいますか？　1. はい　2. いいえ

⑥ バスや電車を使って外出できますか？
1. 一人でできる　2. 介助があればできる　3. できない

⑦ 一人で隣近所へは外出できますか？
1. 一人でできる　2. 介助があればできる　3. できない

⑧ 日中、寝床にどのくらい就いてますか？
1. ほとんど床から離れている
2. 離れている時間の方がやや長い
3. 床に就いている時間の方がやや長い
4. ほとんど床に就いている

裏のアンケートにもぜひお答え下さい。

あなたの生活満足度と日常生活習慣についておたずねします。

問5	あなたの現在の生活満足度と生活習慣についておたずねします。 当てはまる番号を選んでください。

① 去年と比べて同様に元気だと思いますか?
1. はい　2. いいえ　3. どちらともいえない

② 全体として、あなたの今の生活は幸せであると思いますか?
1. はい　2. いいえ　3. どちらともいえない

③ 最近、小さなことを気にするようになったと思いますか?
1. はい　2. いいえ　3. どちらともいえない

④ あなたの人生をふりかえってみて満足できますか?
1. はい　2. いいえ　3. どちらともいえない

⑤ 朝食を毎日食べていますか?
1. ほぼ毎日食べる　2. 時々食べる　3. ほとんど食べない

⑥ お酒を飲んでいますか?
1. ほとんど飲まない　2. 週1-2回　3. 週3-5回　4. ほぼ毎日

⑦ タバコを吸っていますか?
1. 以前から吸わない　2. やめた　3. 吸っている

⑧ 昼寝も含めて1日の睡眠時間は何時間くらいですか?
1. 6時間以下　2. 7－8時間　3. 9時間以上

⑨ 散歩や軽い運動をしていますか?
1. ほとんど毎日　2. 週に3～4回位　3. 週に1回位　4. 月に1回位

⑩ 地域活動やボランティア活動をしていますか?
1. よくしている　2. たまにする　3. ほとんどしていない

⑪ 旅行や行楽を楽しんでいますか?
1. よくしている　2. たまにする　3. ほとんどしていない

⑫ 趣味を持っていますか?
1. 二つ以上持っている　2. 一つだけ持っている　3. 持っていない

あなたの家庭環境と人間関係についておたずねします。

問6	現在、誰と一緒に暮らしていますか？ 当てはまる全てに○を囲んでください。

1. 一人暮らし　2. 配偶者（夫または妻）　3. 子供
4. 子供の嫁　5. 孫　6. その他（　　　　）

問7	あなたの日頃のおつきあいについてうかがいます。

① 外出することがどのくらいありますか？
1. ほとんど毎日　2. 週に3～4回ぐらい
3. 月に4～5回ぐらい　4. 月に1回ぐらい

② 友人や近所の方とおつきあいをしていますか？
1. ほとんど毎日　2. 週に3～4回ぐらい
3. 月に4～5回ぐらい　4. 月に1回ぐらい

③ 身の回りに、一緒にいてほっとする人がいますか？
1. とても多くいる　2. かなりいる　3. ほとんどいない　4. いない

④ 身の回りにちょっとした用事やお使いをしてくれた人がいますか？
1. とても多くいた　2. いた　3. ほとんどいなかった　4. いなかった

⑤ ペット（犬や猫など）の世話をしていますか
1. よくしている　2. たまにする　3. ほとんどしない　4. しない

⑥ 牛や豚などの家畜の世話をしていますか
1. よくしている　2. たまにする　3. ほとんどしない　4. しない

問8	あなたが、一ヶ月で自由に使えるお金（おこづかい）はいくらですか？

一ヶ月で、自由に使えるお金は、＿＿＿＿＿万円です。

問9	去年1年間のあなた方（ご夫妻の合計）の収入はどのくらいでしたか？（年金や 仕送りも含めてください。）

1. なし
2. 100万円未満
3. 100～200万円未満
4. 200～300万円未満
5. 300～400万円未満
6. 400～500万円未満
7. 500～700万円未満
8. 700～800万円未満
9. 800～900万円未満
10. 900～1000万円未満
11. 1000万円以上
12. 答えたくない

ご協力ありがとうございました。お元気にてお過ごしください。ぜひご返送下さい。

APPENDIX B:

Questionnaires for Tama City

〒206-0024

様

いきいきとした高齢者社会
のためのアンケート調査　ーお願い

多摩市長　　鈴 木 邦 彦

平素より多摩市の保健福祉行政に対しましては、格別のご理解・ご協力をいただき、ありがとうございます。

このたび、６５歳以上の全高齢者に対し、アンケート調査を実施いたします。この調査は、高齢者の生活実態を把握し、市の保健福祉計画策定に役立てるとともに、回答される方々が、「寝たきりや痴呆をできる限り遅らせ、生活の満足度と主観的な健康感を高め、日々生活に役割を持ち楽しく暮らす」ことの意義を再認識していただくことも、目的の一つに考えております。

今回の調査では、調査内容の検討から調査内容の分析等の作業について、東京都立大学都市研究所のご協力をいただいております。

皆様のご返送いただいたアンケートは、全てコンピュータにより統計分析し、本調査以外には使用いたしませんが、保健福祉制度の利用が必要と思われる方にはお声がけさせていただくことも考えております。

なお、一部の方々に対し、この調査を補完しより内容を高めるために、交通手段や住宅環境等の問題について訪問調査を考えております。ご協力をお願いいたします。

平成１３年９月２７日

記入方法

1．お答えは、番号　を○でかこんでください。　例ー　1・2・③・4

2．調査票は、同封した封筒に入れ、１０月１２日までにご返送ください。

お問い合わせ

多摩市健康福祉部在宅福祉課

電話　３７５－８１１１内線2621

この調査票は、出来るだけ、ご本人がお答えください。ご本人がお答え出来ない場合にはご家族の方が記入されても結構です。その際は、ご本人の立場でお答えください。

問1　この調査はどなたが回答されましたか　　1）本人　2）本人以外の方

問2　ご本人以外が回答された場合は、その理由を選んでください。

1）多忙　2）病気・けが　3）入院中　4）不在
5）　　・理解力なし　　6）拒否　　7）その他

問3　現在のお住まいに自分も含めて何人でくらしていますか？　　（＿＿人）

問4　現在、誰と一緒にくらしていますか？当てはまるすべてに○を囲んでください。

1）一人暮らし　　2）配偶者（夫または妻）　　3）子供
4）子供の嫁　　5）孫　　6）その他

問5　あなたのお住まいについておたずねします

5－1　現在のお住まいは、次のどれにあたりますか

1）戸建て住宅　　2）集合住宅（1階～5階）　　3）集合住宅（6階以上）

5－2　現在のお住まいは何階にあたりますか？　　（[　　] 階）

5－3　現在のお住まいの所有形態は次のどれにあたりますか？

1）持ち家（分譲）　2）借家（賃貸）

5－4　現在のお住まいにエレベーターはありますか　　（1）ある　2）ない）

5－5　現在のお住まいには何年間住んでいますか？　　（約＿＿＿＿年）

5－6　現在のお住まいに今後も住み続けたいですか？

1）今の住居に住み続けたい　　　　3）どちらでもない
2）できれば他の住居に移りたい

問6　あなたのお体の状態について、お尋ねします

6－1 最近、痛みを感じる所があれば、すべてに○をつけてください。

1）腰　　2）膝　　3）腕　　4）足　　5）首
6）肩　　7）背中　　8）その他　9）なし

6－2　あなたが、現在治療を受けている疾病がありますか、あてはまるものすべてに○をつけてください。

1）高血圧　2）脳卒中（脳梗塞、脳出血、くも膜下出血など）3）糖尿病
4）心臓病（心筋梗塞、狭心症、不整脈など）　5）肝臓病　　6）その他
7）なし

問７　普段から治療を受けたり健康について相談をする「主治医」について伺います。

７－１　主治医（歯科を除く）は、いらしゃいますか（１）いる　２）いない）

７－２　主治医は多摩市にいらしゃいますか　（１）多摩市内　２）多摩市外）

７－３　その医師の診療科目は何ですか

１）内科　２）整形外科　３）外科　４）その他

７－４　歯科の主治医は、いらっしゃいますか　（１）いる　２）いない）

７－５　歯の主治医は多摩市にいらっしゃいますか（１）多摩市内　２）多摩市外）

問８　あなたの生活機能や、生活の満足度、生活習慣について、お尋ねします。

８－１　自分で日用品の買い物ができますか？　１）はい　２）いいえ

８－２　自分で食事の用意ができますか？　１）はい　２）いいえ

８－３　自分でトイレに行けますか？　１）はい　２）いいえ

８－４　自分でお風呂に入れますか　１）はい　２）いいえ

８－５　自分で預貯金の出し入れができますか？　１）はい　２）いいえ

８－６　自分で年金や保険の書類が書けますか？　１）はい　２）いいえ

８－７　新聞や書物を読んでいますか？　１）はい　２）いいえ

８－８　一人で隣近所に外出ができますか？

（１）一人でできる　２）介助がいればできる　３）できない）

８－９　あなたが利用する主な交通手段はなんですか１つだけ○をつけてください

（１）徒歩のみ　２）自転車　３）バイク　４）バス　５）タクシー

６）電車　７）自動車（運転）　８）自動車（同乗）　９）その他）

８－10　外出した際の歩行時間はどれくらいですか？　（約＿＿＿＿分）

８－11　日中あなたは、寝床にどのくらい就いていますか

（１）ほとんど床から離れている　２）離れている時間の方がやや長い

３）床についている時間の方がやや長い　４）ほとんど床についている）

問９　あなたの生活満足度と日常生活習慣についておたずねします。

９－１　あなたはご自分で健康だと思いますか

（１）とても健康である　２）まあまあ健康である

３）あまり健康ではない　４）健康でない）

９－２　昨年とくらべて同様に元気だと思いますか？

（１）はい　２）いいえ　３）どちらともいえない）

9－3　あなたのご自身の生活に満足していますか

1）はい　2）いいえ　3）どちらともいえない

9－4　お酒を飲んでいますか

1）ほとんど飲まない　2）週1～2回　3）週3～4回　4）ほぼ毎日

9－5　タバコを吸っていますか

1）以前から吸わない　2）やめた　3）吸っている

問10　あなたの地域活動や趣味活動についてお伺いします。

10－1　地域活動やボランティア活動をしていますか

1）よくしている　2）たまにする　3）ほとんどしていない

10－2　趣味活動を積極的にされていますか

1）活発にしている　2）活発ではない

10－3　上記で「活発でない」とお答えになられた方は、その理由をどのようにお考えですか、該当するものに○をつけてください（2つまで）

1）仲間はいるが活動の場がたりない　2）活動費用の負担が大変である
3）自分の希望する活動が近くでされていない　4）新しい仲間がみつけられない
5）新しい人と交わるのは気後れする　6）意欲が乏しい
7）忙しくて時間がない　8）特に理由はない

問11　あなたの家庭環境と人間関係についてお伺いします。

11－1　外出することはどのくらいありますか

1）ほとんど毎日　2）週3～4回　3）月に1回ぐらい　4）めったにしない

11－2　友人や近所の方とおつきあいをしていますか

1）ほとんど毎日　2）週3～4回　3）月に1回ぐらい　4）めったにしない

11－3　身の回りにちょっとした用事やお使いをしてくれる人がいますか

1）沢山いる　2）数人はいる　3）ほとんどいない　4）いない

11－4　去年1年間のあなた方（ご夫婦の合計）の収入はどのくらいでしたか（年金や仕送りも含めます）

1）なし　7）500～700万円未満
2）100万円未満　8）700～800万円未満
3）100～200万円未満　9）800～900万円未満
4）200～300万円未満　10）900～1000万円未満
5）300～400万円未満　11）1000万円以上
6）400～500万円未満　12）答えたくない。

福祉制度の充実について伺います

問１２　第２次多摩市健康福祉推進プランについて、お伺いします。特に充実させていくべきだと思われる施策をお選びください（２つまで)。また、新たな施策がある場合には具体的に記入してください。

１）健康づくり　２）在宅ケア　３）いきがいづくり
４）居住環境の整備　５）施設の整備
６）具体的内容（　　　　　　　　　　　　　　　　）

問１３　お住まいの地域で暮らしつづけるうえで、どのようなサービスを充実させていくべきか、特に希望されるサービス（施策）をお選びください（２つまで）

１）外出時の移動を支援するサービス　２）緊急時の援助　３）生活費の援助
４）保健婦などの相談体制　５）高齢者向け住宅の充実
６）いきがい活動や自立を支えるサービス　７）趣味活動の場の確保
８）地域医療（往診やかかりつけ医）の充実
９）買い物の利便　10）その他　11）特に望むものはない

介護保険制度について　お伺いします。

問１４　あなたは、現在介護保険制度の要介護認定を受けていますか

１）受けていない　２）受けている

問１５　あなたは、現在介護保険サービスを受けていますか

１）受けていない　２）受けている

問１６　多摩市の６５歳以上高齢者の介護保険料は、所得に応じて５段階となっています。あなたのご意見をお聞かせください。

１）今と同じでよい
２）高額所得者からより多く徴収し、所得の低い人の保険料を安くしたほうが良い
３）所得の低い人の保険料を安くし、その分をみんなで負担し合うのが良い
４）その他（　　　　　　　　　　　　　　　　）
（所得の低い人とは市民税が課税されていない世帯に属す方などをいいます。）

ご協力　ありがとうございました。

このアンケート調査につきましては、今後の高齢者施策を検討していく上で、大変重要な資料になると考えております。集計の過程では、市が所有している資料を活用し、より有意義なものにしていきたいと考えております。

また、回答内容を見せて頂く中で、市の保健福祉サービスの対象と思われる方々には、ご案内をさしあげたいと考えておりますので宜しくお願いいたします。

いきいきした高齢社会のためのアンケート調査のお願い

多摩市長　渡辺　幸子

平素より、多摩市の福祉行政に格別のご理解、ご協力をいただきありがとうございます。

このたび、多摩市では、高齢者の生活実態を把握し、一人ひとりの方が健康で、いきいきと暮らせる施策の充実を図るため、市内にお住まいの６５歳以上の皆様に対しアンケート調査を実施いたします。

この調査は、多摩市の高齢者保健福祉計画及び介護保険事業計画を策定するための貴重な資料となるとともに、「寝たきりや痴呆をできる限り遅らせ、健康で楽しく暮らす」ための重要な調査と考えております。また、地域の中で安心して生活していただけるよう、支援を必要とする方が気軽に相談いただける仕組みづくりに役立ててまいりたいと考えております。

なお、調査の中で答えたくない質問があれば、無理にお答えいただく必要はありません。そのまま次の質問にお進みください。

また、途中までのご回答でも結構です。なお、本調査にご協力いただけない場合でも、不利益が生じることはありません。

今回の調査は、東京都立大学都市研究所と共同で実施しており、皆様にご回答いただいたアンケート結果は、全てコンピュータで数量的に処理し、統計分析いたしますので、個人情報が外部に漏れることはありません。また、本アンケートの調査結果は、調査の目的以外には使用いたしません。

以上の趣旨等をご理解いただき、アンケート調査にご協力のほど、よろしくお願い申し上げます。

平成１６年９月６日

記入方法

1　ご回答は番号を○で囲み、(　　)内に数字か文字をご記入ください。
2　この調査票は、できるだけご本人がお答えください。
3　ご本人が回答できない場合には、ご家族の方が記入されても結構ですが、ご本人の立場でお答えください。

●　調査票は、ご記入の上、このまま同封の返信用封筒に入れ、<u>9月24日までにご投函ください。</u>

●　お問い合わせ先　　多摩市健康福祉部高齢福祉課　高齢福祉係
電話　042－338－6807
(問16～問28については)介護保険課　介護保険係
電話　042－338－6901

調査票

（ここから調査開始です）

問１　あなたご自身についてご記入ください。

１　年齢	満（　　　　）歳	平成16年9月1日現在
２　性別	１）男性　　２）女性	
３　身長	（　　　　）センチメートル	肥満度を算定します
４　体重	（　　　　）キログラム	

問２　回答された方におたずねします

問２－１　この調査はどなたが回答されましたか。

１）本人　　２）本人以外

問２－２　ご本人以外が代理回答された場合は、その主な理由を<u>１つ</u>○で囲んでください。

１）多忙　　２）病気・けが　　３）入院・入所中　　４）不在
５）痴呆・理解力なし　６）聴力障害　７）視力障害　８）言語障害
９）答えたくない　10）その他（　　　　　　　　）

問３　ご家族のことをおたずねします。

問３－１　現在、誰と一緒にくらしていますか？該当する<u>すべて</u>を○で囲み、<u>合計人数</u>もご記入ください　※２世帯住宅は同居に含みます。

１）一人暮らし　　２）配偶者　　３）子供　　４）孫　　５）親
６）兄弟姉妹　　７）その他（　　　　　　　　）

合計人数（　　　）人　※ご自分を含めた人数です

問３－２　身の回りの世話や用事をしてくれる人はどなたですか？該当する<u>すべて</u>を○で囲んでください。

１）家族・親族　２）友人　３）近所の人　４）ホームヘルパー
５）その他　　６）なし

問３－３　緊急時に連絡の取れる方はいらっしゃいますか。

１）いる　　２）いない

問３－４　もし震災が起きたら、近くの一時避難場所まで避難できますか。

１）自分でできる　　２）介助があればできる　　３）できない

問４　お住まいについておたずねします。

問４－１　現在のお住まいは、次のどれにあたりますか。

１）集合住宅（エレベータなし）　　２）集合住宅（エレベータあり）
３）戸建て住宅・２階建てタウンハウス

問４－２　<u>**問４－１で１）の集合住宅（エレベータなし）にお住まいの方**</u>に、居住階や転居希望についておたずねします。

・居住階は何階ですか？（　　　）階
１）できれば低層階に移りたい　　２）いまのままで良い

問４－３　現在のお住まいは、次のどれにあたりますか。

１）持ち家　　２）借家

問４－４　現在のお住まいに今後も住み続けたいですか。

１）今の住居に住み続けたい　　２）できれば他の住居に移りたい
３）どちらとも言えない

問５　「かかりつけ医」やお体の状態についておたずねします。

問５－１　治療や健康について相談をする「かかりつけ医」がいますか？

１）いる　　２）いない

問５－２　現在治療を受けている病気の<u>すべて</u>を○で囲んでください。

１）高血圧　　２）脳卒中（脳梗塞、脳出血、くも膜下出血など）
３）糖尿病　　４）心臓病（心筋梗塞、狭心症、不整脈など）
５）肝臓病　　６）高脂血症　　７）がん　　８）うつ病　　９）痴呆
10）虫歯・歯周病　　11）胃腸病　　12）目の病気（白内障など）
13）骨・関節の病気（骨粗鬆症、関節症など）
14）呼吸器系の病気（気管支喘息、慢性気管支炎など）
15）その他（　　　　　　　　　　）　　16）なし

問５－３　過去１年間に入院したことがありますか。

１）はい（病名　　　　　　　）（延べ入院日数　　　日間／年）
２）いいえ

問５－４　最近、痛みを感じる所があれば、すべてを○で囲んでください。

１）首　２）肩　３）腕　４）背中　５）腰　６）膝
７）足　８）その他（　　　）　９）なし

問５－５　**問５－４で痛みを感じる所があった方**におたずねします。
最も痛い場所の痛みの程度を、１つだけ○で囲んでください。

１）弱い痛み　２）中程度の痛み　３）強い痛み　４）最悪の痛み

問５－６　過去１年間に転倒や、転倒に伴う骨折をしたことがありますか。

１）骨折なしの転倒　２）骨折ありの転倒　３）転倒なし
※転倒した場所はどこですか　（１）家の中　（２）家の外

問５－７　過去１年間に体重の変化がありましたか。

１）約（　）キロ増加した　２）約（　）キロ減少した　３）変化なし

問６　ふだんの生活についておたずねします。

１.自分で日用品の買い物ができますか。	１)はい　２)いいえ
２.自分で食事の用意ができますか。	１)はい　２)いいえ
３.自分でトイレに行けますか。	１)はい　２)いいえ
４.トイレが間に合わず失禁することがありますか。	１)はい　２)いいえ
５.自分でお風呂に入れますか。	１)はい　２)いいえ
６.自分で預貯金の出し入れができますか。	１)はい　２)いいえ
７.自分で請求書の支払いができますか。	１)はい　２)いいえ
８.自分で年金や保険の書類が書けますか。	１)はい　２)いいえ
９.新聞や書物を読んでいますか。	１)はい　２)いいえ
10.続けて１キロぐらい歩くことができますか。	１)はい　２)いいえ
11.転ぶのが怖くて外出を控えることがありますか。	１)はい　２)いいえ
12.健康についての記事や番組に関心がありますか。	１)はい　２)いいえ
13.友人の家を訪ねることがありますか。	１)はい　２)いいえ
14.家族や友人の相談にのることはありますか。	１)はい　２)いいえ
15.病人を見舞うことはできますか。	１)はい　２)いいえ
16.若い人に自分から話しかけることはありますか。	１)はい　２)いいえ

問７　運動やスポーツの習慣についておたずねします。

問７－１　運動やスポーツをどの位していますか。

１）ほぼ毎日　２）週３～４回位　３）週１～２回位
４）月１～２回位　５）していない

問７－２　１日の平均的な運動時間や、定期的にするようになってどの位ですか。（問７－１で５）に回答した方を除く）

平均（　　　）分位/日　　　継続期間（　　　）年位

問７－３　運動やスポーツを行う際の仲間はいますか。（問７－１で５）に回答した方を除く）

１）10人以上の人と　　　２）数人の人と　　　３）いない

問８　現在の食生活ついておたずねします。

問８－１　次の項目ごとに摂取回数を１つ〇で囲んでください。

	毎日食べる	週 5~6日	週 3~4日	週 1~2日	食べない
１．肉料理	1	2	3	4	5
２．大豆食品（豆腐・納豆など）	1	2	3	4	5
３．卵・卵料理	1	2	3	4	5
４．背の青い魚（サバ・サンマなど）	1	2	3	4	5
５．乳製品（牛乳・ﾁｰｽﾞ・ﾖｰｸﾞﾙﾄなど）	1	2	3	4	5
６．果物	1	2	3	4	5
７．野菜料理（生野菜、煮物など）	1	2	3	4	5
８．塩蔵品（塩サケ・漬物・梅干など）	1	2	3	4	5
９．味付けの濃い物	1	2	3	4	5
10．油を使う料理（揚げ物、炒め物等）	1	2	3	4	5
11．朝食	1	2	3	4	5
12．おやつ・間食	1	2	3	4	5

問８－２　１日の食事回数は何回ですか。

１）１回　　２）２回　　３）３回　　４）４回以上

問８－３　ひとりで食事をする回数は、１日のうち何回ですか。

１）３回以上　　２）２回　　３）１回　　４）１回もない

問９　健康感や日常の生活習慣についておたずねします。

問９－１　ご自分で健康だと思いますか。

１）健康である　　　　　　２）まあまあ健康である
３）あまり健康ではない　　４）健康でない

問９－２　昨年とくらべて元気だと思いますか。

１）はい　　２）いいえ　　３）どちらともいえない

問９－３　現在の生活に満足していますか。

１）はい　　２）いいえ　　３）どちらともいえない

問９－４　お酒はどの位飲んでいますか。

１）ほぼ毎日飲む　　２）週３～４回位飲む
３）週１～２回位飲む　　４）ほとんど飲まない

問９－５　タバコを吸っていますか。

１）吸っている　　２）やめた（　　年前）　　３）以前から吸わない

問９－６　**<u>問９－５で１）又は２）とお答えになった方</u>**におたずねします。

喫煙本数：１日平均（　　）本程度（だった）
喫煙期間：およそ（　　）年

問９－７　昼間寝床から離れていますか。

１）ほとんど寝床から離れている　　２）寝床から離れている時間の方が長い
３）寝床についている時間の方が長い　　４）ほとんど寝床についている

問９－８　毎日、大体何時間の睡眠（昼寝を含む）をとっていますか。

１）６時間未満　　２）６時間～９時間未満　　３）９時間以上

問９－９　毎日の生活でイライラやストレスを感じていることがあれば、あてはまるもの<u>**すべて**</u>を○で囲んでください。

１）人間関係（家族・親戚など）　　２）仕事上のこと
３）自分や家族の健康　　４）家族の介護　　５）住居
６）子供・孫の育児・教育　　７）近所づきあい　　８）なし
９）その他（　　　　）

問１０　地域活動や楽しみや生きがいについておたずねします。

問１０－１　地域活動やボランティア活動をしていますか。

１）している　　２）たまにする　　３）ほとんどしていない

問１０－２　**<u>問１０－１で２）又は３）とお答えになった方</u>**におたずねします。活動しづらい理由があれば、**<u>主な理由を２つ</u>**○で囲んでください。

１）活動の場が少ない	２）活動費用がかかる
３）希望する活動がない	４）仲間がみつけられない
５）人と交わるのは気後れする	６）意欲がわかない
７）時間がない	８）何をしていいか分からない
９）出かけるのがおっくう	10）特に理由はない

問１０－３　楽しみや生きがいは何ですか、あてはまるものを**<u>５つまで</u>**○で囲んでください。

１）運動・スポーツ、あるいは散歩など体を動かすこと
２）趣味・娯楽・読書　３）知人や友人・近所とのつきあい
４）サークル・地域活動
（町会、高齢者クラブ、ボランティア・社会貢献などへの参加）
５）旅行など　６）家族との団らん
７）仕事（アルバイト、内職を含む）　８）孫・ひ孫の世話
９）生涯学習（パソコン・俳句・英会話など）
10）家庭菜園　11）園芸　12）森や樹木とのふれあい
13）ハイキング　14）登山　15）とくにない
16）その他（　　　　　　　　　　　　　　　　）

問１１　生活環境についておたずねします。

問１１－１　一人で隣近所に外出ができますか。

１）できる　２）介助があればできる　３）できない

問１１－２　バスや電車を使って一人で外出できますか。

１）できる　２）介助があればできる　３）できない

問１１－３　日常的に利用している主な交通手段を**<u>２つ</u>**○で囲んでください。

１）自転車　２）バイク　３）バス　４）タクシー
５）リフト付き福祉タクシー　６）電車・モノレール
７）自動車（自分で運転）　８）自動車（同乗）
９）その他（　　　　　　　　　　　　）　10）なし

問１１－４　外出回数（隣近所を含む）は、どのくらいですか。

１）ほぼ毎日　　２）週３～４回位　　３）週１～２回位
４）月２～３回以下　　５）月１回以下

問１１－５　友人や近所の方とのお付き合いをしていますか。

１）ほぼ毎日　　２）週３～４日　　３）週１～２日　　４）月３回以下

問１１－６　近くに、ちょっとした用事やお使いをしてくださる人がいますか。

１）たくさんいる　　２）数人いる　　３）ほとんどいない　　４）いない

問１１－７　昨年１年間の収入はどのくらいでしたか。

１）ご本人（　　　　）万円　　２）配偶者（　　　　）万円
３）答えたくない

問１１－８　経済的に満足していますか。

１）満足している　　２）まあまあ満足している
３）あまり満足していない　　４）満足していない

問１１－９　現在、収入のあるお仕事をしていますか。

１）している　　２）していない

問１１－１０　<u>**問１１－９で1）とお答えになった方**</u>へ、収入になる仕事をされる日数は何日ですか。

１）ほぼ毎日　　２）週３～４日位　　３）週１～２日位
４）月２～３日　　５）月１日以下

問１１－１１　最後に卒業した学校はどちらですか。該当する番号を○で囲んでください。　※（　）内は就学年数

１）尋常小学校（６）　　２）旧制高等小学校（２または３）
３）実業学校（３）　　４）旧制中（女）学校（４または５）
５）旧制専門学校（４）　　６）新制小学校
７）新制中学校　　８）新制高等学校
９）専門学校　　10）短期大学　　11）大学（旧制も含む）
12）大学院　　13）その他　　14）学校にはいかなかった
15）答えたくない

問１２　自分が年を重ねることについて、どう思われますか。

問１２－１　自分の考えに近いものを、__１つ__○で囲んでください。

1）良いことだ	2）良くないことだ	3）どちらともいえない

問１２－２　自分の役割について、年を重ねるにつれてどのように感じていますか。当てはまるものを__１つ__○で囲んでください。

1）重要になった	2）あまり変わらない	3）重要でなくなった

問１３　「病気は、自分自身で気をつけることで、防ぐことができる」といった考え方について、どのように思われますか?
当てはまるものを__１つ__○で囲んでください。

1）その通りである	2）そうではない	3）どちらともいえない

問１４　市の福祉についておたずねします。

問１４－１　在宅介護支援センターをご存じですか？

1）知っている	2）知らない

問１４－２　いきがいデイサービスセンターをご存じですか？

1）知っている	2）知らない

問１４－３　市で特に充実させるべき高齢者福祉に関する施策は次のどれですか。__３つまで__選んでください。

1）在宅介護支援センター等身近な相談窓口
2）見守り・ささえあい施策
3）介護予防・筋力向上トレーニング教室の開催
4）会食・食事配達サービス　　5）外出支援・移動サービス
6）痴呆に関する学習会　　7）成年後見制度に関する学習会
8）住宅の住み替え促進施策
9）その他（＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿）
（＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿）

問１５　一人暮らし、または高齢者のみの世帯の方におたずねします。

問１５－１　緊急連絡先を、市役所または在宅介護支援センターに伝えることを希望されますか？

1）はい	2）いいえ

問１５－２　健康や介護などのことで、市役所または在宅介護支援センターにご相談したいことがありますか？

1）はい	2）いいえ

ここからの質問（問16から問28）は、要介護認定（要支援認定含む）を受けている方に伺います。
要介護認定を受けていない方は、以上で質問は終了となります。最後のページ下段をご覧ください。

問１６　現在、本人が認定されている要介護度は、次のうちどれですか。

１）要支援　２）要介護１　３）要介護２　４）要介護３
５）要介護４　６）要介護５

問１７　現在、要介護認定を受けているご本人は、８月中に介護保険サービスを利用しましたか。

１）利用した　２）利用していない

問１８　**問１７－で２）とお答えになった方**へ、介護保険サービスを利用しない理由はなんですか。主な理由を**１つ**○で囲んでください。

１）家族で介護しているので、制度を利用する必要がない
２）利用したいサービスがない
３）利用者負担がかかるため、利用したくても利用できない
４）サービス利用の方法や手続きがよくわからない
５）治療が必要なため、医療機関へ入院している

問１９　ケアプランのことについておたずねします。現在のケアプラン（サービスの利用内容）について、満足していますか。

１）とても満足している　２）まあまあ満足している
３）あまり満足していない。　４）不満である

問２０　**問１９で３）又は４）とお答えになった方**へ、ケアプランに不満な理由はなんですか。**該当するすべてを**○で囲んで下さい。

１）本人や家族の希望が反映されていない
２）希望した回数や時間が確保されていない
３）希望したサービスが入っていない
４）希望しないサービスが入っている
５）希望する事業者のサービスが入っていない

問２１　ケアプランを作成するときに**誰に相談しましたか。**
該当するすべてを○で囲んで下さい。

１）ケアマネジャー
２）家族
３）友人・知人
４）誰にも相談しないで、本人だけで作成した
５）ケアマネジャーが本人に相談なく勝手に作成した
６）家族が本人に相談なく勝手に作成した

問２２　ケアマネジャー（ケアプランを作成する事業者）をどのようにして選びましたか。あてはまるものを**１つだけ**○で囲んでください。

１）介護保険になる前から利用していた事業者
２）市から提供された事業者名簿「Ｗｅ　ａｒｅ　ケアマネジャー」（ケアマネジャー写真入りパンフレット）を参考にして選んだ
３）新聞の折込や事業者からの宣伝、ダイレクトメール（ハガキなど）を見て
４）知人、友人からの情報（クチコミなど）で選んだ
５）在宅介護支援センターの職員から話を聞いて選んだ
６）家族が選んできた

問２３　担当のケアマネジャーをかえることができるのを知っていますか。どちらかを○で囲んでください。

１）知っている　　２）知らなかった

問２４　現在の担当ケアマネジャーは本人にとって何人目ですか。
どちらかに○を囲んでください。

１）初めて（１人目）　　２）２人目以上

問２５　**問２４で２）とお答えになれた方**へ、
ケアマネジャーがかわった（かえた）理由は何ですか。
主な理由を**１つだけ**○で囲んでください。

１）ケアマネジャーと意見が合わなかったため
２）ケアマネジャーが適切なサービスをしてくれなかったため
３）ケアマネジャーはよくやってくれたが、事業所の都合のため
４）本人の都合のため。（転居、入院等）

問２６　ケアマネジャーは、少なくとも月に１回以上は利用者のお宅を訪問することとなっていますが、現在のケアマネジャーは月に１回以上は訪問に来ていますか。あてはまるものを**１つだけ**○で囲んでください。

１）月１回以上は、訪問に来てくれている
２）２ケ月に１回位は、訪問に来てくれている
３）３ケ月に１回位は、訪問に来てくれている
４）全くと言っていいほど、訪問には来てくれていない

問２７　介護保険の「利用票」をケアマネジャーから受け取っていますか。あてはまるものを**１つだけ**○で囲んでください。

１）受け取っている　　２）受け取っていない　　３）わからない

問２８　ケアマネジャーと契約を結ぶとき，契約の内容等について説明がありましたか。あてはまるものを**１つだけ**○で囲んでください。

１）本人にわかりやすい説明があった
２）本人には、むずかしかったが一応の説明はあった
３）本人には、説明はなく、ケアマネジャーに言われるままに契約した
４）家族が契約したのでよくわからない

これで質問は終了です。長い時間ご協力いただきまして、誠にありがとうございました。
恐れ入りますが、記入ミス・記入もれがないか、もう一度お確かめの上、同封の返送用封筒に回答票（アンケート用紙）を入れ、ご投函ください。

福祉や介護のことでご相談がありましたら、
多摩市役所　高齢福祉課　相談支援担当（電話　３３８－６８４６）
までお電話ください。