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# Trends in disability (2001–2019), chronic medical conditions (1996–2020), and mortality (1995–2020) in Japanese older adults: analyses based on national datasets

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## Abstract

**Background** The overall health status of older adults in Japan has reportedly improved. However, it is unclear whether such improvement has occurred in the baby boomer generation, the oldest of whom turned 65 in 2015. In addition, the health status of oldest-old adults (aged > 85 years) was not examined extensively in previous studies. This study aimed to characterize trends in disability and chronic medical conditions in adults aged 65–89 years which includes the baby boomer generation.

**Methods** From the Comprehensive Survey of Living Conditions (2001–2019), Patient Survey (1996–2020), and Vital Statistics (1995–2020), we documented disability rates, rates of treatment for nine chronic medical conditions (malignant neoplasms, diabetes mellitus, hypertension, ischemic heart disease, cerebrovascular diseases, pneumonia, fractures, osteoporosis, chronic kidney disease, and joint disorders), total mortality rates, and rates of mortality from specific causes (malignant neoplasms, heart diseases, cerebrovascular diseases, and pneumonia) in both sexes and in five age groups (65–69, 70–74, 75–79, 80–84, and 85–89 years).

**Results** Overall, rates of disability decreased significantly in both sexes. Both total mortality rates and rates of mortality from specific medical causes declined significantly. These trends were observed in the baby boomer generation. The rates of treatment for most medical conditions also significantly decreased. However, the treatment rates of diabetes mellitus, pneumonia, and fractures in adults aged 85–89 years remained high or did not decrease. In contrast, the treatment rates of chronic kidney disease steadily increased over time.

**Conclusions** Overall health status continues to improve in older Japanese adults, including the baby boomer generation and the oldest-old cohort. However, for several diseases, no improvement was observed; thus, further public health interventions are necessary.

**Keywords** Cerebrovascular diseases, Health status, Living conditions, Neoplasm, Older adults, Oldest old, Pneumonia

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## Background

The older population has increased gradually worldwide as a result of improved living standards, and the proportion of older people has increased because of declining birth rates [1]. As of 2022, the world population of adults aged ≥ 65 years is 771 million, and this number is projected to reach 994 million by 2030

[1]. As expected, the proportion of older adults in the world will reach nearly 12% in 2030 [1]. In Japan, although the total population is declining, the proportion of older adults has already reached 29.1% in 2023, the highest ratio in the world [2].

The gap between the increasing life expectancy and healthy life expectancy has attracted substantial attention as an indicator of how much of old age is spent in poor health [3]. In 2019, the average life expectancy in Japan was 81.4 years for men and 87.5 years for women, while the healthy life expectancy was 72.7 years for men and 75.4 years for women. This indicates that although women on average live longer than men, they tend to spend more years in poor health [4]. The leading causes of disability in older adults are dementia, cerebrovascular disease, fractures, and falls [5]. According to a previous national study analyzing public databases for chronic medical conditions (1996–2011) and disability (2001–2013) in Japan, the health status of the older adults has improved over the years [6]. The study did not include the oldest baby boomers, those born between 1947 and 1949, as they had not entered old age at the time of the study [6]. The baby boomer generation comprises approximately 8.06 million people, the largest number per generation [7]. Its oldest members will have turned 75 before 2025; thus, the number of older adults aged ≥ 75 years will increase dramatically, as will the accompanying financial burden through rising medical expenses. This scenario is referred to as the "2025 problem" in Japan [8]. Moreover, because this generation was the first born after World War II, their life experiences may differ from those of previous generations; because of such cohort effects, their health conditions may differ from those of previous generations. Therefore, it is unclear whether the improvements in health status observed in previous generations are also occurring in the baby boomer generation. In addition, the health status of the oldest-old adults (aged > 85 years) was not examined extensively in previous studies. The oldest-old population is expected to increase more rapidly than other age groups, and investigation of their health status is urgently needed.

Therefore, we aimed to characterize the trends in disability and chronic medical conditions among older adults. Using data publicly available from the Japanese government, we were able to assess the health trends of the baby boomer generation and those of the oldest-old cohort. We hypothesized that the prevalence of disability and the trends of chronic medical conditions in the baby boomer generation would tend to improve, whereas some medical conditions in the oldest old would not improve.

## Methods

We used a retrospective descriptive study design to analyze health data from 1996 to 2020. Because the data used in this study are publicly available on the Japanese government's official website, ethical review of the data was deemed unnecessary according to the ethical guidelines of the Ministry of Health, Labour and Welfare [9].

The Comprehensive Survey of Living Conditions, Patient Survey, and Vital Statistics are conducted by the Ministry of Health, Labour and Welfare, whose details and tabulated data are available on the website of the Statistics Bureau, Ministry of Internal Affairs and Communications and were retrospectively analyzed in this study [10–12].

### Comprehensive survey of living conditions

In this cross-sectional national survey, the focus is on randomly stratified samples of households with their members. Beginning in 2001, a questionnaire about long-term care has been administered every 3 years to collect data about people who require long-term care (approximately 6000 individuals), according to the National Census, in 2500 districts. The results of this questionnaire reflect the proportion of individuals certified for long-term care under the Long-term Care Insurance System per 100,000 population (hereafter referred to as the "disability rate"), which is approximately equivalent to the prevalence of disability.

### Patient survey

In this cross-sectional national survey, the focus is on randomly stratified samples of medical institutions, including hospitals with more than 500 beds and outpatient clinics. Because of the Tohoku earthquake and tsunami on March 11, 2011, the survey conducted in that year did not include data from medical institutions in Fukushima Prefecture or in the Ishinomaki and Kesennuma medical areas of Miyagi Prefecture.

At each medical institution, the surveys were performed during a designated 3-day period in October of each year. Physicians completed the questionnaire and collected information on patients who were receiving continuous medical care at their institutions and had visited the institution on the day of the survey. The *International Classification of Diseases,* Ninth Revision (*ICD-9*), was used to categorize diseases and injuries in the surveys until 1995, and the Tenth Revision (*ICD-10*) was used thereafter [13].

For each disease or injury, the "treatment rate" was calculated as the estimated number of patients receiving treatment divided by the estimated population and then

multiplied by 100,000. The estimated number of patients who continuously received medical care was estimated according to the following formula [14]:

Estimated number of patients receiving medical treatment = Estimated number of inpatients + Estimated number of outpatients at initial visit + (Estimated number of outpatients at return visit × Average interval since last visit × Adjustment factor [6/7])

The adjustment factor is used to make adjustments based on the operating days of the medical facilities, which are typically open six days a week.

The treatment rate can be considered an approximation of the prevalence of medical conditions.

According to the Comprehensive Survey of Living Conditions in 2022, the most common cause of disability was dementia, followed by cerebrovascular disease, bone fractures, and falls [5]. In this study, we investigated the following medical conditions because of their clinical significance, prevalence, potential to cause disability, and availability of data: malignant neoplasms (ICD10:C00–C97), diabetes mellitus (ICD10:E10–E14), hypertension (ICD10:I10–I15), ischemic heart disease (ICD10:I20–I25), cerebrovascular diseases (ICD10:I60–I69), pneumonia (ICD10:J12–J18), fractures (ICD10:S02, S12, S22, S32, S42, S52, S62, S72, S82, S92, T02, T08, T10, T12, T14.2), osteoporosis (ICD10:M80–M82), and chronic kidney disease (ICD10:N18) [3, 15, 16]. Joint disorders (osteoarthritis (ICD10: M15–M19) and inflammatory polyarthropathies (ICD10: M05–M14)) were also added because they are primary factors that lead older adults to need nursing care in Japan [10].

### Vital statistics

Data on birth, marriage, and death registrations were collected from family registries. The data on total mortality rates and rates of mortality from cerebrovascular disease, ischemic heart disease, pneumonia, and malignant neoplasms were obtained. Family registries in Japan also include death certificates. These certificates are issued by physicians according to the criteria set by the Ministry of Health, Labour, and Welfare of Japan (MHLW) [17]. If physicians determine that a death is related to an injury or illness, they specify the cause of death accordingly.

### Statistical analysis

We categorized the data by sex and evaluated the trends in disability rate, rates of treatment of medical conditions, and mortality rates in five age groups: 65–69, 70–74, 75–79, 80–84, and 85–89 years. The linear trend test was performed with R 4.2.0 (The R Foundation, Vienna, Austria) to evaluate the overall increasing or decreasing trends in the rates in each sex, with adjustment for the age groups. If the result of the initial trend test was statistically significant, linear regression was conducted to assess the trend in each age group. Two-sided *p*-values of $< 0.05$ indicated statistical significance. The direction of the trend was assessed based on the results of the statistical analysis and visual inspection of the log-transformed rate plot.

## Results

### Disability

Overall, the disability rates decreased significantly in both sexes from 2001 to 2019 (Fig. 1). In addition, disability rates declined significantly in each age group except among men aged $\geq 80$ years and among women aged $\geq 85$ years. The disability rate for men aged 80–84 years declined in 2019 compared to 2001. For women aged 85–89 years, from 2004 to 2019, the

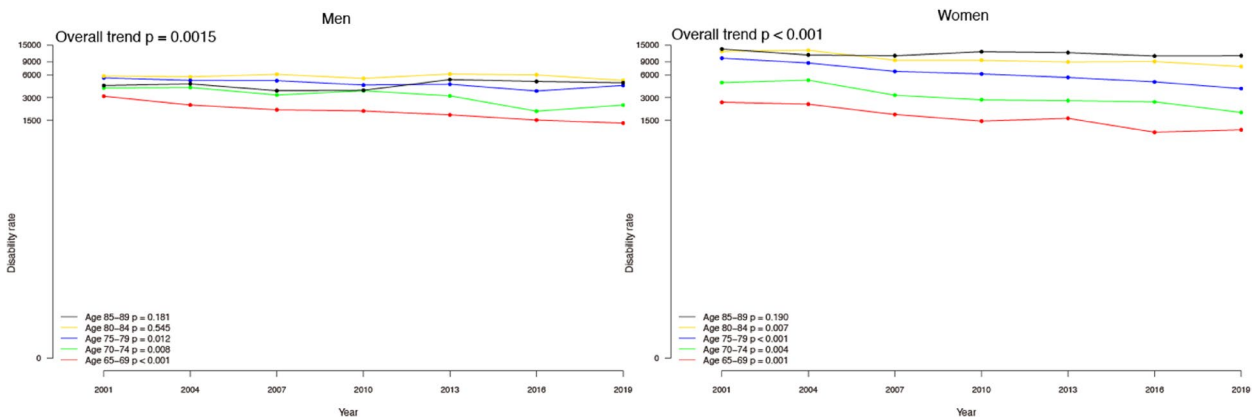


**Fig. 1** Trends in disability from 2001 to 2019. The disability rate is the rate of individuals certified for long-term care under the Long-Term Care Insurance System per 100,000 population

disability rate decreased overall compared to 2001, but not linearly.

### Chronic medical conditions

The treatment rate for most chronic medical conditions from 1996 to 2020 (Fig. 2) declined significantly for each sex; the exceptions were diabetes mellitus, pneumonia, fractures, and chronic kidney disease. For diabetes mellitus in men aged 75–84 years, the treatment rate exhibited a wave-shaped pattern. Among both men and women aged ≥ 85 years, the rate of treatment for pneumonia increased after 1996, peaked in 2005, and then declined steadily. Fractures did not decline significantly among men aged 80–89 years or among women aged 75–84 years. In contrast, the treatment rates for chronic kidney disease significantly increased for both men and women over time. For women, the treatment rates for joint disorders slightly increased and decreased before and after 2011, respectively.

### Mortality

In all age groups, both total mortality rates and rates of mortality from specific medical causes declined significantly from 1995 to 2020 (Fig. 3), except for the rate of mortality from malignant neoplasms among men aged 85–89 years, which declined since 2010.

## Discussion

In our analysis of nationally representative datasets in Japan, we found that mortality rates, treatment rates for chronic medical conditions, and disability rates decreased over time. However, the treatment rates for specific conditions such as malignant neoplasms, pneumonia, diabetes mellitus, and joint disorders fluctuated during certain periods or varied between men and women. In contrast, the treatment rates for chronic kidney diseases increased over time.

In contrast to previous studies, we analyzed data about the baby boomer generation and the oldest-old cohort (aged > 85 years), both of which constitute a significant proportion of the older adult population. During the lives of the baby boomer generation, positive changes that could contribute to improved health conditions included a more sanitary environment, better nutrition, and advances in medical technology and negative changes included westernization of diet, which may increase the prevalence of diabetes and obesity [18]. Our findings demonstrated that the improvement in health conditions persisted in the baby boomer generation.

The treatment and mortality rates of malignant neoplasms decreased in both men and women; however, men consistently exhibited higher rates than women across all age groups. This disparity is mainly attributed to the

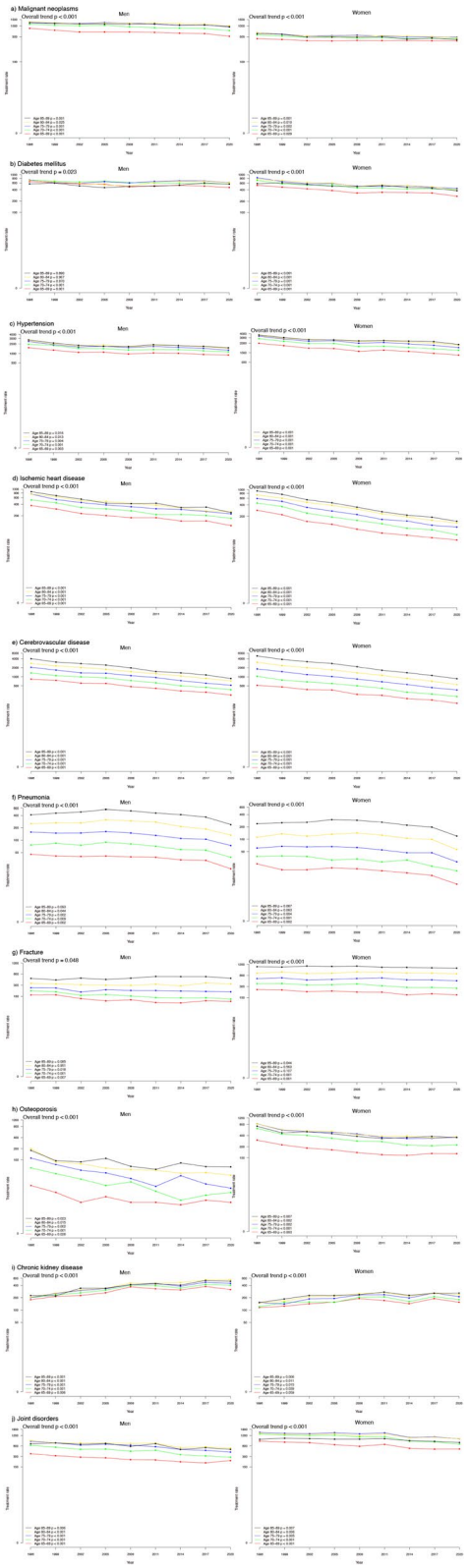


**Fig. 2** Trends in the rates of treatment for chronic medical conditions from 1996 to 2020. The treatment rate is calculated as the estimated number of patients divided by the estimated population × 100,000

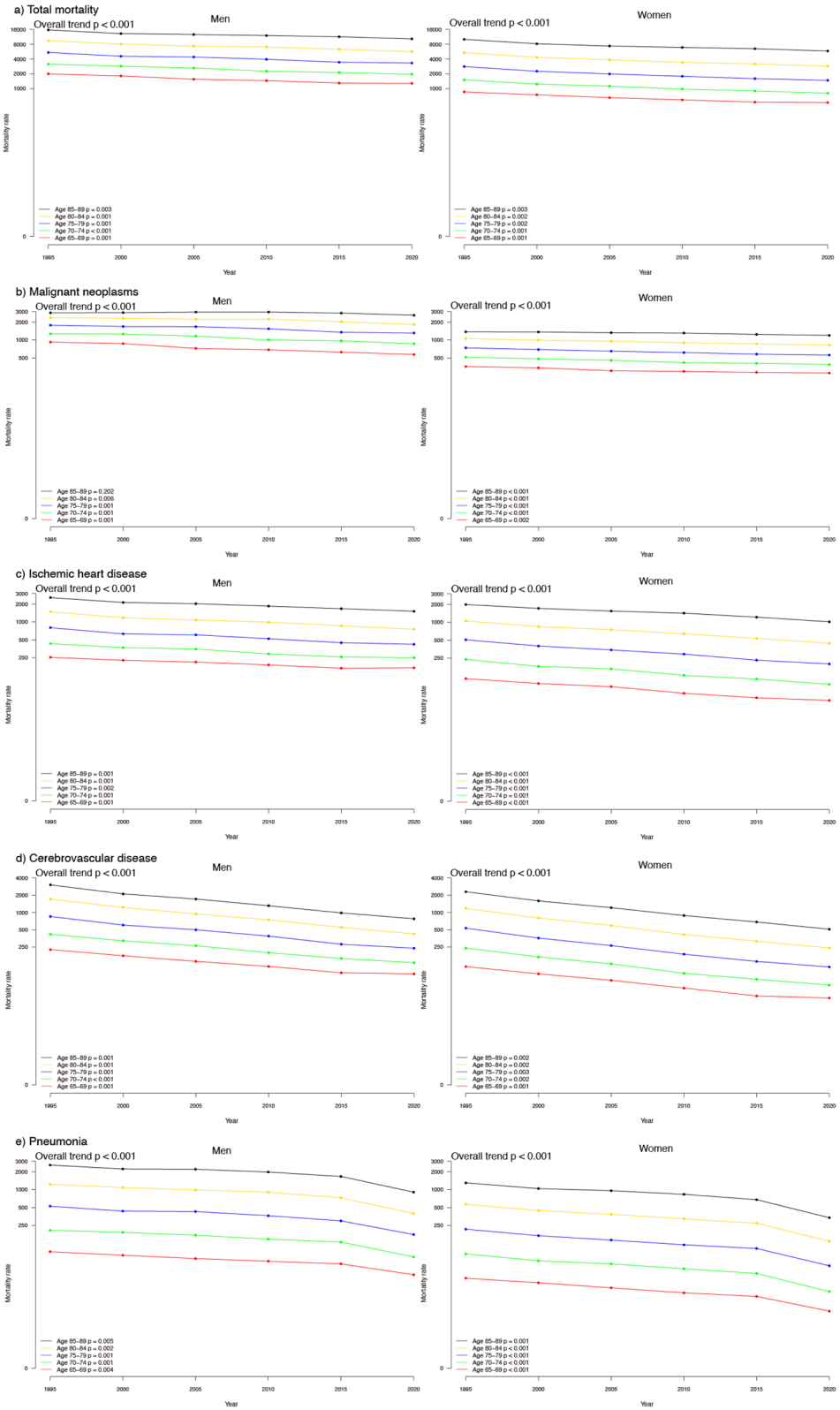


**Fig. 3** Trends in total mortality rate and mortality rates from specific medical causes during 1996–2020. The mortality rate is calculated as the number of deceased divided by the estimated population × 100,000

types of malignant neoplasms that are more prevalent in men. Lung malignancies, the leading cause of malignant neoplasm-related deaths since 1996, shows a marked increase in incidence with advancing age and is twice as common in men as in women [19, 20]. Similarly, malignant neoplasms of the stomach occur more frequently in men [20]. These trends are strongly affected by smoking [21, 22] because men generally have higher smoking rates than women [23]. Moreover, the widespread adoption of prostate-specific antigen testing in Japan since the late 1990s, particularly during health checkups from early 2000s, has led to an increase in the early detection of malignant neoplasms of the prostrate [24]. In contrast, although the incidence of malignant neoplasms of the breast in women is high, it declines with advancing age among older adults aged ≥ 65 years, and the trend is that the mortality rate is coming down [20]. In Japan, the participation rate in female breast cancer screening (mammography) has been increasing, and early stage malignant neoplasms and carcinoma in situ of the breast have been reported to have increased in a study using a prefectural cancer registry [25]. These trends could have partially helped reduce the rise in both the treatment and mortality rates of breast cancer among older women.

We found that for diabetes mellitus, the rate of treatment among men aged 75–84 years showed a wave-shaped trend, increasing since 2008, whereas the treatment rate decreased among women in all age groups. Diabetes mellitus is associated with obesity [26–28]. According to the Japan National Health and Nutrition Survey [23], the obesity rate among men aged ≥ 70 years remained stable at around 21.0% until 2001. Subsequently, it rose to 26.3% in 2002, slightly declined to 25.5% in 2008, increased again to 27.8% in 2010, and eventually reached 28.5% in 2019. This trend in obesity prevalence may partly explain the wave-shaped trend in diabetes treatment rates observed in older men. In contrast, the obesity rate among women aged ≥ 70 years was 30.8% in 2002, which decreased to 26.4% in 2019 [23]. Hence, the sex difference observed in the rate of diabetes treatment might be in part a result of the sex difference in obesity prevalence. Another plausible explanation is cohort effect in Japan; changes in lifestyle habits between birth cohorts, particularly in dietary intake, since World War II may account for this trend [18]. As older adults age, the incidence of diabetes mellitus increases [29]. Older men, in particular, tend to consume less dietary fibers, with lower intakes of calcium and essential vitamins, which are protective against diabetes mellitus [30].

For pneumonia, treatment rates for both sexes increased in 1996, peaked in 2005, and steadily declined thereafter. At the same time, mortality rate of pneumonia declined, especially in the oldest men and women, aged ≥ 85 years, since 2005. An event likely contributing to the increase in pneumonia cases in 2005 was the influenza epidemic that affected an estimated 17.7 million patients nationwide from September 2004 to August 2005 [31]. Similarly, during the influenza epidemic from September 2017 to April 2018, approximately 22.49 million patients were affected, higher than that during the 2004–2005 epidemic [32]. Nevertheless, no corresponding increase in the incidence of pneumonia was observed during this latter period. Therefore, the relationship between the influenza epidemic and rapid increase in pneumonia treatments in 2005 remains unclear. By 2009, the rate of PPSV23 vaccination among older adults had reached only 7.7% [33]. In 2014, a national routine pneumococcal vaccination program was launched for those aged ≥ 65 years [34]. This program included PPSV23 as the primary vaccine for adults and catch-up cohorts. By the end of 2015, the estimated vaccination rate increased to 40.6%, a significant rise from 25.4% in June 2013 [35, 36]. This increase in vaccination coverage may explain the decline in both the treatment and mortality rates of pneumonia, as a previous study reported that prior pneumococcal vaccination was associated with shorter hospital stay and reduced in-hospital mortality from all causes [37].

Since the introduction of ICD-10 in 1996, aspiration pneumonia has been classified under the J69.0 category, defined as "pneumonitis due to food and vomit." According to the MHLW, approximately 70% of pneumonia patients are older adults ≥ 75 years, and more than 70% of pneumonia cases among this demographic were identified as aspiration pneumonia in 2016 [38]. This study classified pneumonia as a pathogen-related disease, excluding aspiration pneumonia. While the exclusion of aspiration pneumonia may have marginally contributed to the lower mortality rates for pneumonia, it does not fully explain the overall decline in these rates, especially considering that the ICD-10 classification system remained consistent from 1996 to 2000.

The mortality rate of pneumonia was lower in women than in men. This disparity may be partially explained by the higher prevalence of smoking among men than among women [23]. A previous study showed that current smokers have a significantly higher risk of pneumonia than non-smokers [39]. Additionally, although differences in lifestyle habits and health awareness between sexes may also play a role [23], direct evidence linking these factors to the mortality rate of pneumonia remain lacking. Therefore, the underlying reasons for the sex differences in the mortality rate of pneumonia in Japan are not yet fully understood.

In a prospective observational study with 10.4 years of follow-up, fracture risk at multiple sites attributable

to osteoporosis ranged from only 10% to 44% among women aged ≥ 65 years at baseline [40]. Moreover, risk factors for fracture independent of osteoporosis were reported: advanced age, previous fragility-related fracture, high-dose glucocorticoid treatment, neuromuscular disorders, family history of hip fracture, low body weight, cigarette smoking, and diabetes mellitus [41, 42]. In older adults, age-related decline in vision and motor functions contribute to increased fracture risk [43, 44]. We found that the rates of treatment for fractures were high or did not decrease significantly over time among men aged 80–89 years or among women aged 75–84 years, possibly because of the presence of risk factors other than osteoporosis, whereas the rates of treatment for osteoporosis decreased.

Conversely, treatment rates for chronic kidney disease increased almost significantly across all age groups in both men and women over time. This increase may be attributed to several factors. One of the significant risk factors for chronic kidney disease in older adults is diabetes mellitus [45]. In our study, the treatment rates of diabetes mellitus in men aged ≥ 75 years did not improve over time. Another contributing risk factor for chronic kidney disease is obesity, which is defined in Japan as body mass index ≥ 25 kg/m$^2$ [45]. In Japan, the obesity rates among older adults are notably higher than those among young adults [46]. Between 2003 and 2017, the obesity rates for men were 20.9–34.1% for ages 60–69 years and 14.8–26.8% for ages 20–29 years; for women, they were 21.7–30.3% for ages 60–69 years and 5.4–10.7% for ages 20–29 years. Moreover, the chronic kidney disease treatment guidelines in Japan were updated in 2007 [47], and advancements in treatment methods likely led to a higher proportion of patients receiving treatment than in the past.

The treatment rate for joint disorders among women has declined sharply since 2011. This trend may be partially attributed to the 2000 launch of "Health Japan 21," which focused on the primary prevention of lifestyle-related diseases and the extension of healthy life expectancy [48]. Furthermore, among women aged ≥ 70 years, the proportion engaging in regular exercise increased from 27.1% in 2003 to 36.3% in 2014 and further to 42.3% in 2017 [49]. This increase in physical activity may have alleviated symptoms of lower limb osteoarthritis [50], a prevalent condition in older women [51]. While these factors may partly explain the decline in treatment rates, direct evidence has yet to be established to confirm a causal relationship with the observed reduction.

The results of this study have significant implications for older adults with chronic medical conditions possibly linked to death or disability. The results must be interpreted cautiously for countries other than Japan because our data might have been affected by public health policy, people's lifestyles, and socioeconomic status in Japan [10, 23]. Moreover, the widespread use of advanced medical technology in Japan can improve indexes associated with chronic medical conditions; thus, the results may depend on the level of medical care in other countries. Nonetheless, the high rates of treatment for diabetes mellitus and fractures were not improved in the oldest-old adults (aged ≥ 85 years) in Japan, suggesting that specific medical care policies (e.g., adequate nutrition and exercise intervention or health assessment through regular health checkups) for these illnesses in this age group should be implemented.

Our study had some limitations. First, the patient survey collected information on diseases and injuries from physicians, but the diagnostic criteria were not standardized, and their severity was not covered in the questionnaire. For patients with multiple comorbidities, the questionnaire may not capture all medical conditions; this is a particular concern for older adults because they tend to have increasing numbers of comorbid conditions [52]. Second, the patient survey is conducted every 3 years in October, and it therefore does not account for seasonal variation in the treatment rate. However, because each survey is conducted in a standardized manner at the same time of the year, the data can provide valid estimates of the treatment rates over time. Third, dementia was excluded from our analysis because its treatment rate is not considered to reflect its prevalence. Small-scale studies have reported that the proportion of diagnosed dementia cases ranges from approximately 30% to 50% [53, 54]. Furthermore, even if dementia is diagnosed, it is not included in the treatment rate data unless the patients receive treatment. Factors such as a shortage of dementia specialists and regional differences in access to medical services contribute to discrepancies between diagnosis and treatment rates [55]. Fourth, aspiration pneumonia was not analyzed in this study because aspiration pneumonia, coded as J69.0 in the ICD-10, is not considered viral or bacterial pneumonia in the patient survey or included among the vital statistics used in this study. Therefore, the results with regard to pneumonia must be interpreted cautiously. The rates of treatment for aspiration pneumonia may increase with age because aspiration pneumonia is related to diseases that are common in older adults, such as stroke, impaired swallowing, and dementia [56]. In future studies, researchers must investigate the effect of aspiration pneumonia on older adults by using methods other than the patient surveys used in this study. Fifth, the patient survey data in 2011 did not include data from medical institutions in areas affected by the Tohoku earthquake and tsunami; however, the populations in these areas constituted less than 3% of the population of Japan, and exclusion of data from these areas was unlikely to bias

our findings and alter our conclusion. Finally, the mortality rates used in this study accounted for only one underlying chronic medical condition as the primary cause of death; however, other chronic medical conditions can influence mortality, considering that many older adults have multiple chronic diseases [3].

## Conclusion

Most rates of disability, chronic medical conditions, and mortality have decreased over time among older adults in Japan, including the baby boomer generation and the oldest old. In contrast, the rates of treatment for some medical conditions causing disability did not decrease but rather increased among older adults. Therefore, adequate public health policies and healthcare services must be devised to effectively prevent these medical conditions.

### Abbreviations

| | |
|---|---|
| DALY | Disability-adjusted life-years |
| ICD | International Classification of Diseases |
| MHLW | Ministry of Health, Labour, and Welfare |
| PPSV23 | 23-Valent pneumococcal polysaccharide vaccine |

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Not applicable.

### Authors' contributions

HJ and SI contributed to the study design, data acquisition, statistical analysis, interpretation of the results, and manuscript preparation. MA participated in the study and reviewed the manuscript. All authors read and approved the final manuscript.

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None.

### Data availability

Data are available from the Japanese government's official website (URL: https://www.e-stat.go.jp/stat-search/files?page=1&toukei=00450061; https://www.e-stat.go.jp/stat-search/files?page=1&toukei=00450022&tstat=000001031167; https://www.e-stat.go.jp/stat-search/files?page=1&toukei=00450011&tstat=000001028897).

## Declarations

### Ethics approval and consent to participate

The data used in this study are publicly available on the Japanese government's official website. Ethical review of the data was deemed unnecessary and no consent to participate was required.

### Consent for publication

Not applicable.

### Competing interests

The authors declare no competing interests.

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