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# The estimation of the clinical status of the residents in a geriatric health service facility in Japan

Toyoki Maeda[a,*]

[a] *Social Medical Corporation San-aikai Geriatric health services facility Tabaru, Hukada 936-1-1, Tabaru, Oita 870-1154, Japan.*

## Abstract

In order to introduce the current status of residents in geriatric care facilities in Japan, which has become a super-aging society, we investigated the relationship between the age of residents of a care facility, the level of care they needed, their estimated telomere length, the number of teeth they had left, medical history, body temperature, and body mass index (BMI). Our findings indicated that in the facility's male residents, aging was linked to cancer, stroke, and lumbar fracture, while in female residents, it was associated with hypertension. Tooth loss appears to begin from the left side of the mouth as an individual ages, affecting both men and women regardless of gender, individuals with a history of stroke often require a high level of care and exhibit high body temperatures. Conversely, cancer survivors typically had low body temperature. These observations suggest a possible connection between individual body temperature and the pathologies of stroke and cancer. Among women, those who had previously contracted COVID-19 or urinary tract infections needed more care. However, women with hypertension require less care. Patients with dementia tended to maintain their BMI and required less care, likely due to the challenges families face in providing care. These traits highlight the characteristics of elderly individuals residing in care facilities and suggest that the reasons for entering such facilities extend beyond aging and increased care needs, involving a wide range of other factors as well.
**Keywords:** Geriatric assessment, geroscience, longevity, nursing home issues

## Introduction

Japan's elderly population is increasing at the fastest pace globally, and more people are finding it difficult to live independently due to the decrease in physical activity associated with aging [1].

Based on Article 8, Paragraph 28 of the Nursing Care Insurance Act: a geriatric health services facility is defined as a place that offers nursing care, functional training, and other essential medical care and daily living support, all under a doctor's supervision. This is intended for individuals who need nursing care or assistance and cannot live at home, to maintain and restore their physical and mental functions as outlined in a facility service plan [2].

* Corresponding author: Toyoki Maeda
Mailing address: Social Medical Corporation San-aikai Geriatric health services facility Tabaru, Hukada 936-1-1, Tabaru, Oita 870-1154, Japan.
Email: maedat_0717@yahoo.co.jp
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Geriatric health service facilities cater to elderly individuals with diminished physical abilities, including those who cannot manage daily life at home with their families due to chronic illnesses. I believe that the factors related to care for residents of elderly care facilities might be intricately interrelated, so I began researching the interrelationships between multiple factors that seem to be related to care, such as aging, physical condition, and pre-existing diseases.

## Materials and methods

The analysis focused on 131 residents who were admitted to the Tabaru nursing home in Oita City between April 2022 and December 2023. Their profiles are detailed in Table 1. The physical conditions assessed included the level of required care, body temperature, body mass index (BMI), number of remaining teeth at the time of admission, and medical history.

The subaxillary temperatures of the subjects were measured around 10:00 a.m. daily for one week following their admission, using an electronic underarm thermometer (Electronic underarm thermometer, C207, TERUMO

**Table 1.** The profiles of the residents, detailing both their age-related parameters and physical characteristics.

| | Whole | Men | Women |
|---|---|---|---|
| *Max*. BT | 36.7 ± 0.25 | 36.7 ± 0.20 | 36.7 ± 0.28 |
| *Min*. BT | 36.1 ± 0.23 | 36.1 ± 0.19 | 36.1 ± 0.25 |
| Remaining teeth | 12.7 ± 10.56 | 18.1 ± 9.35 | 10.1 ± 10.15 |

**Note:** The values are presented as the mean value ± standard deviations. Abbreviations are explained within the Text..

CORPORATION, Tokyo). For analysis, the highest and lowest temperatures recorded (*max*. BT and *min*. BT) were considered.

The required level of care was determined based on criteria established set by the Ministry of Health, Labor and Welfare of Japan, which defined the daily care time as follows: Level 1 requires 32 to less than 50 minutes, Level 2 requires 50 to less than 70 minutes, Level 3 requires 70 to less than 90, Level 4 requires 90 to less than 110 minutes, Level 5 requires 110 minutes or more.

Upon admission, blood tests were conducted after obtaining informed consent from the subjects or their families. The estimated telomere length (eTL) was calculated using a formula based on clinical blood data, as follows [3]:

eTL (kb) (Men) = 8.59–0.037 × Age (years) + 0.024 × Hb (g/dL)

eTL (kb) (Women) = 4.83–0.019 × Age (years) + 0.23 × Alb (g/dL) + 0.0001 × WBC (/mm$^3$) + 0.0020 × RBC (× 10$^4$/mm$^3$) + 0.0032 × TC (mg/dL).

Note: Hb for Hemoglobin, Alb for Serum albumin, WBC for white blood cell count, RBC for red blood cell count, and TC for serum total cholesterol.

In this investigation, the subjects' age and eTL were employed as parameters associated with aging. No studies have investigated the telomere length of residents of geriatric care facilities at the genomic DNA level. The decline in physical performance associated with aging is related to the telomere shortening related to aging [4]. We devised a formula to calculate the estimated telomere length using clinical blood data, eliminating the need to extract DNA from patients' somatic cells. This approach allows us to estimate past somatic telomere length from individuals' clinical data records.

It is anticipated that analysis using both age and eTL will be more sensitive in detecting aging and aging-related findings compared to using age alone.

The subjects' BMI was calculated from their height and weight at the time of admission. A dental hygienist counted the remaining teeth of the subjects at the time of admission.

## Results

The patients were categorized into groups above and below the average age and average eTL, and the relationship between body temperature, BMI, level of care required, number of remaining teeth, and each aging factor was examined (Table 2).

Despite an approximate six-year gap in the average age between men and women, the estimated average telomere length was nearly identical, indicating a similar rate of aging among residents regardless of gender.

Significant correlations between physical status and age-related factors were discovered only in women. Older women had fewer teeth, and lower eTL was linked to reduced levels of caregiving in women. Meanwhile, residents of long-term care facilities generally retained their physical activity capacity regardless of age.

When analyzing the relationship between individual tooth loss and aging parameters, men in the short TL group were more likely to lose teeth in the upper left region of the mouth while preserving their lower right anterior teeth (Table 3). In women, tooth loss in the upper left, lower left, and lower right regions was significantly more common in the older age group, with lower right tooth loss being notably more frequent in the short TL group.

Past or current illnesses associated with age-related pa-

**Table 2.** The relationship between the residents' physical characteristics and their aging-related parameters.

| | **Men** | | | | | |
|---|---|---|---|---|---|---|
| | **Age (years)** | | | **eTL (kb)** | | |
| | **> Av** | **< Av** | ***P*-value** | **> Av** | **< Av** | ***P*-value** |
| Level of care | 2.79 ± 1.56 | 3.16 ± 1.38 | 0.420 | 3.00 ± 1.32 | 2.93 ± 1.59 | 0.870 |
| Remaining teeth | 16.50 ± 9.93 | 20.05 ± 8.40 | 0.211 | 20.75 ± 7.88 | 16.48 ± 9.91 | 0.128 |
| | **Women** | | | | | |
| | **Age (years)** | | | **eTL (kb)** | | |
| | **> Av** | **< Av** | ***P*-value** | **< Av** | **> Av** | ***P*-value** |
| Level of care | 3.05 ± 1.25 | 3.24 ± 1.48 | 0.521 | 3.49 ± 1.26 | 2.79 ± 1.39 | 0.001* |
| Remaining teeth | 7.33 ± 9.22 | 12.88 ± 10.41 | 0.010* | 11.69 ± 9.72 | 8.33 ± 10.42 | 0.273 |

**Note:** The values are presented as the mean value ± standard deviations. Av indicates the average. * represent as having a *P*-value of less than 0.05.

**Table 3.** The count of remaining teeth among the residents examined.

| Age | | | eTL | | |
|---|---|---|---|---|---|
| > Av | < Av | *P*-value | > Av | < Av | *P*-value |
| 13 | 13 | 0.351 | 12 | 14 | 0.128 |
| 11 | 14 | 0.065 | 13 | 12 | 0.012* |

**Note:** "Av" represents the average. * represent as having a *P*-value of less than 0.05.

rameters included cancer, lumbar fracture, and ischemic heart disease in men, while hypertension was the primary condition in women (Table 4).

Regarding the correlation between past or current illnesses and body temperature, men with a low maximum body BT was more commonly cancer survivors, whereas those with a high *max*. BT were more likely to have a history of stroke. Meanwhile, in women, a high *max*. BT to a higher prevalence of arrhythmias and strokes, while a high *min*. BT was more common among hypertensive patients. Conversely, a low *min*. BT was more frequently observed in cancer survivors. In both men and women, individuals with a history of stroke generally had higher body temperatures, whereas cancer survivors tended to have lower body temperatures.

The association between pre-existing diseases and BMI was only observed in women, with dementia and chronic kidney disease being more common in those with a higher BMI.

Regarding the relationship between pre-existing diseases and the level of care required, men with a history of stroke were more prevalent in the high-care group while those with hypertension were more common in the low-care group. This suggests that hypertension may not directly impact the level of care needed.

When analyzing the total number of remaining teeth, no significant correlation between tooth loss and pre-existing diseases was found in either men or women.

## Discussion

Because mean leukocyte telomere length is inversely linked to daily physical activity capacity, as measured by the Barthel index [5], telomere shortening is believed to be linked to increased difficulty in living at home due to reduced physical function. In this analysis, the eTL was 5.8 kb for both men and women upon admission to the elderly care facility, suggesting that a reduction in mean leukocyte telomere length to 5.8 kb may serve as an indicator of the challenges of independent living.

Age-related changes in body temperature, BMI, required care level, and number of remaining teeth were observed only in women, showing a trend of increasing care needs and decreasing tooth count. The absence of a similar trend in men may be attributed to the significantly smaller number of men included in the analysis.

The decline in physical function and the progression of aging in elderly care facilities do not always follow a parallel trajectory, showing a different pattern compared to the general elderly population. This discrepancy highlights the unique characteristics of elderly care facilities. It suggests that these facilities accommodate individuals with physical impairments that are not solely attributed to aging. Additionally, elderly care facilities play a crucial in rehabilitating residents, helping them to regain their ability to perform daily activities by enhancing their remaining physical functions.

The number of remaining teeth revealed a tendency for women to experience loss of teeth with age. However, when examining individual teeth, men also exhibited age-related tooth loss, particularly in the upper left region of the mouth, whereas women lost teeth in the upper left, lower left, and lower right areas. This suggests that in both men and women, the left or upper left side of the mouth is more susceptible to age-related tooth loss than the right side. It is uncertain whether this left-right difference in tooth loss is unique to elderly care facility residents. However, tooth loss on the left or upper left side appears to be an age-related change associated with admission to such facilities. Monitoring the condition of teeth in these areas could serve as a potential indicator for detecting early signs of aging.

When examining specific diseases, cancer, stroke, and lumbar fractures in men, as well as hypertension in women, were more prevalent in the elderly group or those with a short eTL group. This suggests that these conditions are age-related and that the decline in physical activity caused by these diseases contributes to the need for admission to care facilities.

Certain diseases are also linked to body temperature, with associations observed for cancer, stroke, arrhythmia, and high blood pressure. In both men and women, cancer patients tended to have lower body temperatures, while those with a history of stroke exhibited higher body temperatures. Arrhythmia and hypertension were associated with higher body temperatures but only in women. Since these conditions can contribute to strokes, there may be a connection between elevated high body temperature stroke onsets. For cancer survivors, it remains unclear whether their body temperature is a consequence of cancer or if individuals with low body temperatures are more susceptible to developing cancer. However, previous studies have suggested that individuals who bathe in hot springs daily have higher cancer survival rates [6, 7]. This implies that maintaining body temperature may play a role in prolonging the lives of cancer survivors, potentially by reducing the risk of recurrence.

Women with dementia tend to have a higher BMI and require a low level of care. Patients with dementia appear to maintain some level of nutritional status and physical activity. It is assumed that dementia patients enter institutions not because their physical function has deteriorated, but because it is becoming increasingly difficult for them to live a peaceful daily life with their families.

Men and women with a history of stroke were more likely to receive higher levels of care. Women with a history of urinary tract infections were more likely to be in the higher care group, implying that a long-term decline in

**Table 4.** Multivariate analysis of covariance (MANCOVA) test to compare the means of variables in three groups.

| | **Men** | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Age** | | | **eTL** | | | ***Max*. BT** | | | ***Min*. BT** | | | **BMI** | | | **Level of care** | | | **Remaining teeth** | | |
| | **> Av** | **< Av** | ***P*** | **> Av** | **< Av** | ***P*** | **> Av** | **< Av** | ***P*** | **> Av** | **< Av** | ***P*** | **> Av** | **< Av** | ***P*** | **> Av** | **< Av** | ***p*** | **> Av** | **< Av** | ***P*** |
| Population | 0 | 19 | - | 16 | 27 | - | 16 | 27 | - | 24 | 19 | - | 19 | 24 | - | 27 | 16 | - | 24 | 19 | - |
| Dementia | 7 | 7 | 0.607 | 7 | 7 | 0.258 | 8 | 6 | 0.080 | 8 | 6 | 0.707 | 6 | 8 | 0.906 | 10 | 4 | 0.417 | 6 | 8 | 0.253 |
| DM | 8 | 6 | 0.906 | 4 | 10 | 0.417 | 5 | 9 | 0.891 | 10 | 4 | 0.185 | 7 | 7 | 0.607 | 11 | 3 | 0.123 | 8 | 6 | 0.906 |
| Cancer | 8 | 2 | 0.069 | 1 | 9 | 0.020* | 1 | 9 | 0.020* | 7 | 3 | 0.346 | 4 | 6 | 0.766 | 5 | 5 | 0.377 | 7 | 3 | 0.302 |
| HT | 14 | 10 | 0.717 | 7 | 17 | 0.237 | 9 | 15 | 0.966 | 15 | 9 | 0.433 | 12 | 12 | 0.399 | 11 | 13 | 0.006* | 14 | 10 | 0.717 |
| HL | 2 | 5 | 0.141 | 3 | 4 | 0.750 | 4 | 3 | 0.287 | 4 | 3 | 1.000 | 3 | 4 | 0.940 | 5 | 2 | 0.602 | 3 | 4 | 0.475 |
| Arrhythmia | 4 | 1 | 0.232 | 1 | 4 | 0.366 | 2 | 3 | 0.896 | 4 | 1 | 0.252 | 3 | 2 | 0.476 | 3 | 2 | 0.896 | 4 | 1 | 0.232 |
| Apoplexy | 6 | 9 | 0.140 | 8 | 7 | 0.132 | 9 | 6 | 0.033* | 8 | 7 | 1.000 | 6 | 9 | 0.693 | 13 | 2 | 0.009* | 6 | 9 | 0.140 |
| Lumbal fx | 4 | 0 | 0.043* | 0 | 4 | 0.043* | 2 | 2 | 0.614 | 2 | 2 | 0.773 | 2 | 2 | 0.814 | 1 | 3 | 0.177 | 2 | 2 | 0.814 |
| Femoral fx | 1 | 2 | 0.452 | 2 | 1 | 0.356 | 1 | 2 | 0.887 | 2 | 1 | 0.730 | 2 | 1 | 0.452 | 2 | 1 | 0.887 | 2 | 1 | 0.696 |
| CPVID-19 | 7 | 8 | 0.394 | 7 | 8 | 0.374 | 7 | 8 | 0.374 | 8 | 7 | 1.000 | 6 | 9 | 0.693 | 11 | 4 | 0.294 | 7 | 8 | 0.394 |
| CKD | 4 | 3 | 0.940 | 2 | 5 | 0.602 | 2 | 5 | 0.602 | 5 | 2 | 0.399 | 5 | 2 | 0.141 | 4 | 3 | 0.750 | 5 | 2 | 0.360 |
| HF | 6 | 3 | 0.464 | 2 | 7 | 0.275 | 4 | 5 | 0.636 | 5 | 4 | 0.917 | 6 | 3 | 0.151 | 6 | 3 | 0.790 | 7 | 2 | 0.126 |
| IHD | 5 | 1 | 0.127 | 0 | 6 | 0.011* | 3 | 3 | 0.523 | 3 | 3 | 0.716 | 5 | 1 | 0.059 | 5 | 1 | 0.220 | 4 | 2 | 0.566 |
| UTI | 4 | 2 | 0.566 | 1 | 5 | 0.220 | 4 | 2 | 0.167 | 4 | 2 | 0.613 | 3 | 3 | 0.767 | 5 | 1 | 0.220 | 2 | 4 | 0.265 |
| Pneumonia | 7 | 3 | 0.302 | 2 | 8 | 0.174 | 5 | 5 | 0.377 | 7 | 3 | 0.346 | 6 | 4 | 0.275 | 8 | 2 | 0.174 | 4 | 6 | 0.275 |

**Table 4 continued.**

| | Women | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Age | | | eTL | | | *Max*. BT | | | *Min*. BT | | | BMI | | | Level of care | | | Remaining teeth | | |
| | > Av | < Av | *P* | > Av | < Av | *P* | > Av | < Av | *P* | > Av | < Av | *P* | > Av | < Av | *P* | > Av | < Av | *p* | > Av | < Av | *P* |
| Population | 43 | 45 | - | 45 | 43 | - | 46 | 42 | - | 50 | 38 | - | 44 | 44 | - | 38 | 50 | - | 36 | 52 | - |
| Dementia | 19 | 22 | 0.407 | 20 | 21 | 0.684 | 19 | 22 | 0.304 | 22 | 19 | 0.582 | 26 | 15 | 0.019* | 13 | 28 | 0.042 | 15 | 26 | 0.446 |
| DM | 4 | 5 | 0.651 | 6 | 3 | 0.328 | 4 | 5 | 0.651 | 7 | 2 | 0.152 | 6 | 3 | 0.282 | 2 | 7 | 0.171 | 4 | 5 | 0.848 |
| Cancer | 5 | 7 | 0.487 | 6 | 6 | 0.933 | 7 | 5 | 0.654 | 3 | 9 | 0.027* | 4 | 8 | 0.219 | 4 | 8 | 0.454 | 4 | 8 | 0.562 |
| HT | 38 | 24 | 0.003* | 28 | 34 | 0.084 | 32 | 30 | 0.850 | 40 | 22 | 0.029* | 34 | 28 | 0.165 | 25 | 37 | 0.414 | 26 | 36 | 0.765 |
| HL | 15 | 9 | 0.194 | 11 | 13 | 0.548 | 12 | 12 | 0.797 | 13 | 11 | 0.763 | 12 | 12 | 1.000 | 7 | 17 | 0.097 | 14 | 10 | 0.052 |
| Arrhythmia | 4 | 10 | 0.070 | 9 | 5 | 0.286 | 11 | 3 | 0.029* | 9 | 5 | 0.537 | 5 | 9 | 0.249 | 8 | 6 | 0.271 | 5 | 9 | 0.666 |
| Apoplexy | 13 | 20 | 0.091 | 21 | 12 | 0.070 | 22 | 11 | 0.036* | 23 | 10 | 0.056 | 16 | 17 | 0.828 | 23 | 10 | 0.000* | 10 | 23 | 0.113 |
| Lumbal fx | 13 | 6 | 0.089 | 8 | 11 | 0.381 | 10 | 9 | 0.972 | 9 | 10 | 0.363 | 11 | 8 | 0.443 | 6 | 13 | 0.242 | 8 | 11 | 0.906 |
| Femoral fx | 15 | 13 | 0.758 | 13 | 15 | 0.552 | 18 | 10 | 0.124 | 16 | 12 | 0.967 | 15 | 13 | 0.652 | 12 | 16 | 0.967 | 12 | 16 | 0.803 |
| CPVID-19 | 16 | 19 | 0.415 | 20 | 15 | 0.365 | 17 | 18 | 0.578 | 20 | 15 | 0.961 | 16 | 19 | 0.519 | 22 | 13 | 0.003* | 13 | 22 | 0.563 |
| CKD | 2 | 2 | 0.963 | 1 | 3 | 0.296 | 1 | 3 | 0.281 | 2 | 2 | 0.785 | 4 | 0 | 0.044 | 1 | 3 | 0.435 | 1 | 3 | 0.487 |
| HF | 11 | 4 | 0.058 | 6 | 9 | 0.351 | 7 | 8 | 0.639 | 7 | 8 | 0.400 | 7 | 8 | 0.780 | 5 | 10 | 0.393 | 7 | 8 | 0.630 |
| IHD | 11 | 4 | 0.058 | 7 | 8 | 0.708 | 11 | 4 | 0.070 | 8 | 7 | 0.770 | 7 | 8 | 0.780 | 8 | 7 | 0.400 | 5 | 10 | 0.508 |
| UTI | 8 | 10 | 0.531 | 11 | 7 | 0.347 | 13 | 5 | 0.055 | 12 | 6 | 0.340 | 8 | 10 | 0.602 | 12 | 6 | 0.032 | 7 | 11 | 0.847 |
| Pneumonia | 10 | 9 | 0.885 | 9 | 10 | 0.715 | 13 | 6 | 0.110 | 10 | 9 | 0.684 | 6 | 13 | 0.071 | 9 | 10 | 0.684 | 9 | 10 | 0.531 |

**Note:** The number of patients with each disease is listed. "Av" represents the average. * represent as having a *P*-value of less than 0.05. The abbreviations used are as follows: DM for diabetes mellitus, HT for hypertension, HL for dyslipidemia, fx for fracture, CKD for chronic kidney disease, IHD for ischemic heart disease, and UTI for urinary tract infection. Other abbreviations are the same as those explained in the text or used in other tables.

urinary function contributed to institutionalization. This was also true for women who had previously contracted COVID-19, as they experienced long-term declines in physical capacity after COVID-19 infection [8]. Further research is needed to confirm the findings presented here.

## Conclusions

Aging-related diseases associated with admission to elderly care facilities differed between men and women. In men, the most common causes were stroke and lumbar fracture, while in women, the most common causes were hypertension.

Diseases associated with the need for nursing care were stroke in both men and women, and urinary tract infection and history of COVID-19 infection in women.

The number of remaining teeth is presumed to be associated with the need for nursing care. Tooth loss associated with the hallway tended to start on the left side in both men and women.

The average estimated telomere length of elderly care residents was 5.8 kb in both men and women, which may be an indicator of admission to a facility.

Body temperature was not associated with the level of nursing care required, but hypothermia was observed in cancer survivors, and keeping warm may be associated with the life expectancy of people with a history of cancer.

## Declarations

**Author contributions:** Maeda T contributes to data curation, formal analysis, funding acquisition, methodology, project administration, resources, software, validation, visualization, and writing of this manuscript.

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**Conflicts of interest:** Not applicable.

**Ethical approval and informed consent:** This is not an interventional study, but an observational study using clinical data recorded during routine care after hospitalization. Clinical research at TABARU Geriatric Health Care Facility is conducted with comprehensive consent for the use of personal data. In addition, consent for the use of clinical data is also obtained from the residents' families at the time of hospitalization.

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