

gender, living condition and chronic conditions as risk factors of functional decline in Japanese elders, and to associate them with different degrees of disability. The identification of risk factors that correlate with the development of mild disability, and which serve as suitable targets for prevention, is of particular importance in today's society, where increasing prevalence of mild disability and of costly dependency of the aged is clearly apparent [17,18]. The present study is also of interest for its use of a base population in which the proportion of elders, aged 65 and over was 40%. To the best of the author's knowledge, this is the most aged society studied epidemiologically to date.

Prevalence and incidence of disability

This study initially used the disability index to show the occurrence of disability in the population. This index had an exponential distribution, i.e. the most of the elders have no disability as shown in Table 1 and Figure 6, since the sample represents a normal population, as is in a previous study [14].

The speed of disability development was different among age-groups and genders, suggesting that there is different underlying process for developing disability among these groups (Figure 6). To examine this difference, the author divided the disability into two categories; mild and severe disability. And the change was prominent in the mild disability group (Figure 7).

Although the mortality rate of this cohort was within the range of that of other studies, the prevalence of overall disability was higher than in some other studies in Japan [19-21]. One study, for example, reported a lower rate of mobility disability compared to the present study [21]. This may be because of fine categorization in TAI definitions, as it classifies the elders who have problem to climb stairs into mild disability. In a previous study, stair climbing was categorized to be the difficult task, compared to other ADL and mobility items [22]. The measurement instrument in this study employs it as a tool to detect mild disability. Repeated measurement will likely show a higher chance of identifying more disability [23], and the very aged population might also have been responsible for this difference in prevalence.

The present study found an increase of mild disability in the cohort, especially in women. These findings appear to differ from those of previous studies which found that men show a faster decline than women in the Japanese population [21]. However, this result is in accordance with that of women having a longer survival time, and therefore the disability accumulates in women [24]. In woman, the transition from no disability to mild disability was higher in both age groups than men (Table 3). Higher

disability index after 2000 in woman aged 75 and over also supports the accumulation of disability in woman. In men, higher age group showed higher proportion of death in 2002, but it did not apply to the cases of institutionalization. This suggested the non-exponential pattern of increase of disability index median in men (Figure 6) was attributable to the death, but not to institutionalization.

The gender difference of the proportion of elders with severe disability was not as prominent as with mild disability. These results suggest different factors are associated with the development of disability in two genders, especially in the development of mild functional limitation.

Factors associated with disability

Earlier studies in Japan have identified a variety of chronic conditions as related to the development of task specific ADL or IADL disability [19,25,26]. The association of chronic diseases with both physical and cognitive function has been investigated [8,19]. However, to date, no studies using a cohort design and a Japanese sample have reported the association of number and type of chronic conditions with severity levels of disability to the best of the authors' knowledge.

It is reasonable to hypothesize that different kinds of chronic conditions will have different functional sequelae, and there is some empirical evidence both in the US and in Japan that different risk factors are associated with reduced performance on different levels of disability.

Previous non-Japanese studies have estimated the risk associated with chronic conditions for the development of different levels of functional or ADL disability [4,6,7]. In the present study, the principle associates of both levels of disability for men were CVA and malignancy, while in females they were chronic arthritis, CVA and diabetes, as shown in Table 4. These findings are similar, but not identical, to those found in a previous Japanese study [25].

Some chronic conditions might relate to earlier death of the participants. The weak association between the number of chronic conditions and the disability index in earlier years, namely 1997 and 1999, might be due to exclusion of deceased and institutionalized cases.

Of the chronic condition studied, CVA is the most frequently cited as to have association with functional decline [8,25,27], but it has been shown that, because of the short survival time after stroke, the number of dependent elderly persons does not necessarily increase as a result [21]. This study also showed the association of the severe disability and CVA. And the incidence and preva-

lence of disability did not increase as much as the mild disability.

In contrast, chronic arthritis is consistently found to be a risk factor for both genders, and shows no association with mortality [4]. As might be expected, studies have indicated that the prevention of disabilities consequent on non-fatal conditions, such as chronic arthritis, is the most cost-effective preventative strategy [17,18]. The present study confirmed the significance of chronic arthritis, in women only, both for its high prevalence (9%) and its high relative risk for the development of both mild and severe disability.

This study also found the association between diabetes and mild disability in woman. In a Japanese population, Kishimoto et al. reported that, a history of diabetes is associated with poor performance on more ADL tasks in women than in men [26]. Diabetes has been shown to be associated with slower walking speed, inferior lower extremity function, and decreased balance [28], all of which meet characteristics of mild disability in the present study.

Many previous studies have suggested bone fracture and osteoporosis are risk factors for functional disability [29,30]. In the present study, however, while bone fracture and osteoporosis, in women only, appeared to be associated using Fisher's exact test, it failed to show a relationship in the logistic regression model. Ross et al. have suggested that the risk of falls among Japanese women is lower than for Caucasian women [31]. The low prevalence of these conditions in non-disabled persons may have contributed to this result. In addition, it is possible that the six-year analysis interval used in the current logistic regression analysis was too long for the detection of effects of bone fracture [23].

The prevalence of the chronic condition that achieved statistical significance with chi-square test was highest in eye disease in women, but it did not show association in the logistic regression model. Next to it was the chronic arthritis, osteoporosis and bone fracture, followed by the diabetes. In men, chronic lung disease is the highest followed by the CVA then chronic arthritis. This result suggested different approach in prophylaxis is required to prevent accumulation of disability in the population.

Study limitation

The present study has a few limitations. The history of physician-diagnosed chronic medical conditions and self-reports of the same were obtained retrospectively. A previous study had found that self-report of chronic conditions in the elderly was accurate [32], but inaccurate recall of the time of onset of chronic conditions was present, espe-

cially for arthritis [33]. Current ignorance of the prevalence of chronic conditions among well-functioning Japanese elders also limits the interpretation of the prevalence of chronic conditions among this sample. The exclusion from the analysis of participants who died or were institutionalized or emigrated in the course of the study, some of whom may have exhibited a chronic condition at baseline, may also have affected the results since those who were included for the analysis of risk factors were younger and thus were presumably healthier. The absence of information regarding to the levels of severity of the chronic conditions reported, and the relatively low prevalence of each chronic condition, meant that the associations measured were less specific than could be desired. Chronic conditions such as osteoporosis and Parkinson's disease that did not achieve statistical significance in this study may in fact contribute to the development of disability with a larger sample. Some conditions could be related to the development of disabilities in shorter or longer period of observation.

This study did not incorporate those elders who were institutionalized or dead at the endpoint for the analysis of the risk factors. This is because only 24 percent of the institutionalized cases provided responses to the questionnaire study, and none did so in the deceased cases, compared to 90 percent of the surviving cases. Inclusion of these endpoints could have improved association with the risk factors.

In addition, caution should be exercised with regard to extrapolation of the results to other populations due to the use of a single base population. However, the present study does have the advantage of using a whole population rather than a sample. By using geographically defined area, this study had little loss of the data throughout the 7 consecutive years.

Other methodological approach of analysis, such as the use of Structural Equation Model (SEM) could have been more appropriate with this data. However the stability of the model when applied for this analysis was poor, mainly because of the distribution of the endpoint variables used in this study.

Despite the limitations, this study is significant in that it provides information on the incidence and prevalence in Japan of two levels of disability – mild and severe – and gives indication of priorities in the selection of chronic conditions for prophylaxis, especially as regards to the elderly with mild disability over a lengthy period. In the context of long-term care insurance in Japan, and plans to direct services for mildly impaired elderly persons towards rehabilitation, this study can be employed to develop suitable objectives in the prevention of unwanted sequelae of

chronic conditions. This study also suggested that man and woman require different prophylaxis, because different factors were associated with the development of disabilities in two genders.

Population-based studies using TAI in another Japanese town, at two- and six-month observation intervals have been initiated by the author and collaborators, in order better to understand the functional loss process and its risk factors.

Conclusion

This study showed a tendency for mild disability prevalence to increase in Japanese elders, especially in women. This study also identified some risk factors in the development of mild disability; chronic arthritis and diabetes for women and the CVA for men. In Japan, the budgetary balance of the newly instituted long-term care insurance system is endangered by increase in the mildly impaired elderly, and these findings should help determine priorities for prevention.

Competing interests

The author has not received reimbursements, fees, funding, or salary from an organization that may in any way gain or lose financially from the publication of this manuscript, either now or in the future.

The authors does not hold any stocks or shares in an organization that may in any way gain or lose financially from the publication of this manuscript, either now or in the future. I am not applying for any patents relating to the content of the manuscript. The author of this article has not received reimbursements, fees, funding, or salary from an organization that holds or has applied for patents relating to the content of the manuscript. I do not have any other financial competing interests.

Authors' contributions

Jiro Okochi carried out the study design, data collection, statistical analysis and preparation of the manuscript.

Additional material

Additional File 1

The status change of the participants between 1996 and 2002 by gender (n = 1838)

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Additional File 2

Baseline characteristics, prevalence of chronic conditions and endpoint functional status of remaining participants in 2002 (n = 1067)

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