# Incidence of Falls among the Elderly and Preventive Efforts in Japan

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## Abstract

Falls have been an object of study in the Western countries since the 1940s, but it is only 20 years since studies of falls began in Japan. Epidemiological studies of falls among community-dwelling elderly in Japan have produced much evidence, including (1) the incidence of falls ranges from just below 10% up to over 20%, a lower frequency than among the Western elderly; (2) women experience falls at a higher frequency than men, and the incidence of falls increases with age; and (3) although regional differences are apparent, no uniform trend is in evidence. This paper reviews primarily reports on the incidence of falls among community-dwelling elderly in Japan.

Meanwhile, preventive efforts are only just underway. With the introduction of long-term care insurance and the system focused on prevention, programs have been launched over the past three years for the improvement of locomotive functions in the form of long-term care prevention programs inclusive of preventing falls and bone fractures. We have described the partial results of community prevention programs. Going forward, the fall prevention programs are expected to be implemented nationwide.

**Key words** Epidemiological surveys, Incidence of falls, Regional differences, Prevention

## Introduction

A fall is a routine event that anyone might experience, but for the elderly it is a serious mishap that could result in severe medical conditions, such as bone fracture and head injury. According to 2006 Vital Statistics of Japan by the Ministry of Health, Labor and Welfare, "falls" were the cause of 19.3% of deaths resulting from "sudden accidents" among persons aged 65 and over, a proportion second only to "oral sudden chocking." And according to a national survey,[1] femoral neck fractures known as problematic fractures "requiring long-term care," occurred in an estimated 117,900 persons in 2002 and their number is increasing rapidly from year to year. In around 80% of cases, the cause of injury was a "fall."[2] Even where they do not result in bone fracture or other severe injury, falls are known to occasion reduced activity due to a fear of falling again, what is called post-fall syndrome. Falls thus markedly impair activities of daily living (ADL) and quality of life (QOL) among the elderly.

The increase in the number of subjects requiring care has been relentless since the introduction in 2000 of long-term care insurance, and the charges incurred have become a social and economic problem. While the incidence of cerebrovascular disorders has abated in recent years, falls and bone fractures are increasing as a proportion of causes requiring long-term care. Given the expected further aging of the population, preventing falls among the elderly will likely take on even greater significance.

Ascertaining the facts of their incidence is an essential first step in the prevention of falls. This paper thus reviews the incidence of falls among

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**Table 1 Incidence of falls among community-dwelling elderly in Japan**

| Location | Population (% elderly) | Regional characteristics | Subjects (age) | | Falls (%) | | Subjects | Survey methods (response rate) | Source & survey dates |
|---|---|---|---|---|---|---|---|---|---|
| | | | All | Male<br>Female | All | Male<br>Female | | | |
| Otofuke-cho, Hokkaido | c.39,000, 5,829 (15.3%) 65+ | Satellite of Obihiro city Primarily agricultural. Temperature ranges widely: 30°C in summer, −20°C in winter. | 882 (72.2) | 397 (72.0)<br>485 (72.4) | 17.8 | 16.4<br>19.1 | Random sampling of 951 subjects aged 65–84, of which 882 available for study | Survey distributed door-to-door, supplementary questions on collection at later date (92.7%) | Haga[3] Jul 1996 |
| Oiwake-cho, Yufutsu-gun, Hokkaido | 4,061, 1,033 (25.4%) 65+ | Within 50 km of Sapporo. Inland climate with widely ranging temperatures. | 754 | 344 (72.1)<br>410 (72.7) | 20.6 | 19.2<br>21.7 | 871 aged 65+, self-sufficient ADL | Door-to-door interviews (86.5% valid responses) | Haga[4] Sep 1998 |
| Nangai-village, Akita pref. | 5,248 (14.5%) | Agricultural, primarily rice cropping | 685 | 276 (71.8±5.8)<br>409 (72.4±6.1) | 19.9 | 19.2<br>20.3 | Of 719 aged 65+, 685 visiting for general health checkup | Survey sheet interviews (97.0%) | Yasumura, et al.[5] Jul 1988 |
| Nakazato-village, Niigata pref. | 6,776, 1,349 (19.9%) 65+ | Rural snowbelt mountain village | 1,317 | 532 (73.1)<br>785 (74.4) | 19.4 | 17.7<br>20.6 | Full 65+ population | Door-to-door interviews (97.6% response rate) | Yasumua, et al.[6] Sep 1992 to Jun 1993 |
| Nakazato-village, Niigata pref. | 6,567 (25.5%) | As above | 779 | 287 (72.7±6.3)<br>492 (71.4±7.2) | 12.3<br>13.0[a] | 9.4<br>8.9[a]<br>14.0<br>15.6*,[a] | Participants aged 60+ having basic health checkup | Surveys filled out by subjects | Yasumura[6] 1999 (year of report) |
| O-cho, T gun, Saitama pref. | 2,794 65+ | | 1,643 | 645<br>998 | 26.9 | 25.9<br>27.5 | Full 65+ population, questionnaire & physical exam | Questionnaires placed for filling out, collected & inspected at physical exam (64.6% analyzable) | Sakata[7] 2000 survey |
| O-cho, Chiba pref. | 7,741 (16.2%) 65+ | | 475 (73.9±6.0) | 184<br>289 | 22.9 | 14.7<br>28.4 | Questionnaires distributed to 500 aged 65+ via dietary improvement group | Questionnaires distributed for filling out, collected next month (81.0% valid responses) | Ichikawa, et al.[8] Aug 2000 |
| Koganei city, Tokyo | c.100,000 | Urban | 807 | 366 (71.6)<br>441 (72.1) | 17.6 | 12.8<br>21.5** | 10% enrolled in random sampling of 65–84 age group in residents register | Door-to-door interviews (81.0% valid responses) | Yasumura, et al.[9] 1991? |
| Koganei city, Tokyo | | As above | 624 | 285 (75.8±5.1)<br>339 (76.2±5.1) | 12.3 | 9.5<br>14.8* | Residents aged 65–84 at 1991 baseline & resident in 1995 | Interviews | Niino[3] Jul–Aug 1995 |
| Murakushi-cho, Hamamatsu city, Shizuoka pref. | 3,249 (21.7%) | Temperate climate; coastal fishery, horticulture, tourism | 534 | 219<br>315 | 21.2 | 18.7<br>22.9 | Of 705 population aged 65+, those undergoing bone density exam | Interviews; 534 valid responses of 552 visitors & 39 home visits (83.8%) | Kanou, et al.[3] Aug 1996 |
| Hirosawa-cho, Hamamatsu city, Shizuoka pref. | 4,379 (20%) | Temperate, school & residential district near center of Hamamatsu city | 456 (73.7) | 173<br>283 | 20.8 | 19.0<br>22.0 | Of 885 residents aged 65+, those agreeing to "medical exam and survey on health of the elderly and their falls" | Interviews & questionnaires distributed in advance and filled out by subjects | Niino[4] Aug 1999 |

*$P<0.05$, **$P<0.01$, [a] Incidence of falls among subjects aged 65 and over. Source superscripts refer to bibliography numbers.

(Table continued on next page)

**Table 1 Incidence of falls among community-dwelling elderly in Japan (continued)**

| Location | Population (% elderly) | Regional characteristics | Subjects (age) | | Falls (%) | | Subjects | Survey methods (response rate) | Source & survey dates |
|---|---|---|---|---|---|---|---|---|---|
| | | | All | Male<br>Female | All | Male<br>Female | | | |
| Nishibiwajima-cho, Nishikasugai-gun, Aichi pref. | 16,708, 2,802 (16.8%) 65+ | Neighbor Nagoya city | 204 (72.7±8.7) | 40<br>164 | 25.2 | 25.0<br>25.6 | Participants in research group aged 65+, body measurements & interviews | Interviews based on survey sheet; 204 of 286 participants analyzed (70.8%) | Etoh[10] Nov 2003 |
| Mitsugi-gun, Hiroshima pref. | 1,827 65+ | Rural | 1,534 | 624 (73.4)<br>910 (74.5) | 15.2 | 9.5<br>19.1* | All residents aged 65+ | Fill-in questionnaires mailed, collected in visits (88.8% response rate, 84.0% valid responses) | Aoyagi, et al.[11] Jul 1994 |
| Ohshima-cho, Nishisonogi-gun, Nagasaki pref. | c.6,000 (22.5%) | Island 20 min by boat from mainland. Shipbuilding, mixed farming & fishing | 729 | 358 (75.0)<br>371 (74.6) | 15.8 | 14.5<br>17.0 | Random sampling of 100 men & women each from 5-year age groups of all aged 65+ (800 subjects total) | Face-to-face & telephone interviews (91.1% valid responses) | Aoyagi[4] Oct 1999 |
| Urasoe city, Okinawa pref. | 1,364 65+ in 8 of 34 local authorities | Urban | 837 (73.98) | 340<br>497 | 10.9 | 6.8<br>13.7* | All elderly aged 65+ in 8 local authories | Door-to-door interviews | Sakibara, et al.[3] Aug–Oct 1996 |
| Nakijin village, Okinawa pref. | c.9,600, c.2,000 65+ | Rural, northern part of Okinawa island | 1,061 | 316 (73.9±5.9)<br>745 (74.5±6.5) | 12.7 | 11.1<br>13.4 | Participants in "health survey of the elderly" 1997: Women 1998: Men | Interviews at survey station (38% of men, 65% of women participating) | Yoshida[4] Dec 1997 Dec 1998 |

*$P<0.05$, **$P<0.01$, [a] Incidence of falls among subjects aged 65 and over. Source superscripts refer to bibliography numbers.

community-dwelling elderly as found in epidemiological studies conducted in Japan and discusses efforts in falls prevention focused on the perspective for preventing long-term care for the elderly.

## Incidence of Falls in Other Countries

Studies of falls began in the United Kingdom in the 1940s and since have continued, primarily in North America and Europe. Many of these countries report an incidence in falls among the community-dwelling elderly of 30% to 40%. On the other hand, their incidence reported in Japan is, as detailed below, from just under 10% up to over 20%. Although elderly Caucasians in Western Countries are known to have a higher bone density than Japanese—in other words to have "solid, sturdy bones"—Western Caucasians suffer more femoral neck fractures than do Japanese, a peculiar fact the authors term the "femoral neck fracture paradox." However, the results of studies conducted in numerous regions of Japan show that the low incidence of falls explains this paradox to considerable extent.

It goes without saying that international comparison of the incidence of falls involves numerous such factors as race, dietary habits, lifestyle, and the natural and social environments. The difficulty of controlling for these relevant factors leaves it uncertain to what degree specific factors contribute to regional differences in the incidence of falls around the world.

## Incidence of Falls in Japan

Table 1 summarizes the primary findings reported on the incidence of falls in areas around Japan. Due to their listing from north to south in order to highlight regional differences, the surveys are out of order chronologically.

### Influence of age and sex differences

In the urban study[9] conducted by the authors, the incidence of falls among men was 12.8% and among women 21.5%, a significantly higher rate

for the women ($P<0.01$). The incidence of falls among the elderly aged 75 and over was also significantly higher ($P<0.05$) among both men and women than that among the elderly aged 65 to 74. Although some reports indicate no significant sex difference in the incidence of falls, all reports are alike in showing a tendency for a greater incidence among women. Although some reports indicate no significant age difference in the incidence of falls, many reports show a higher incidence of falls among both men and women in those aged 75 and over than among those younger.

### Regional differences

One would imagine that cold, snowy regions have a higher incidence of falls than warm regions because their roads freeze and grow slippery during winter. In fact, however, no clear-cut difference is apparent. Nor do rural or urban areas evidence any characteristic trend in the incidence of falls.

Studies in urban and rural areas of Okinawa have reported a lower incidence of falls among both men and women in either area than in regions in other prefectures. Okinawa has long been known for the longevity of its people due to its distinctive dietary and lifestyle habits and climate. The elderly with longevity means healthy and therefore not susceptible to falls. Conversely, they are not susceptible to falls and can enjoy good health (without requiring long-term care) and therefore lead to live long. Although the causality thus seems not to be unidirectional, one may also note that Japan, with one of the world's highest longevities, has a lower incidence of falls than do North American and European countries.

However, it is not possible to make a straightforward comparison of the incidence of falls within Japan either. The reason why is that methods for surveying and evaluating the incidence of falls are not standardized.

## How to Study Regional Differences in Incidence of Falls

In the first place, the number of falls recorded when counting falls will vary with how a fall is defined. The authors employ Gibson's definition that "falling down to the ground, or to the lower level against one's will,"[12] and many researchers use definitions that accord with this one.

Many researchers use a survey method of face-to-face interviews or distributing questionnaires through the mail for subjects to fill out themselves, asking whether subjects have experienced any falls within the past year. Each method requires the distribution of a survey sheet so that subjects can understand the definition of fall and respond correctly. Because interview technique may influence interview responses, with the interview method it is important for the researchers to employ a standardized interview technique.

The method by which subjects are selected may also affect results. Where subjects are not the total population or a random sample of the elderly in an area thereof but rather self-selected participants in some given learning opportunity, the resulting group may have some bias. Even with unanimous surveys of total populations, attention is required in making comparisons of incidence among groups with different participation rates (response rates). This is because of the possible presence of a selection bias in which survey participants are in better physical and mental health than non-participants. This applies likewise to surveys conducted via the post.

As the incidence of falls is also affected by age and sex, comparisons and investigations must additionally control for the age and sex composition of their groups.

Thus, it is difficult to address differences in the incidence of falls between regions of Japan. A challenge for the future would be to conduct standardized surveys in various regions to explore regional differences.

## Local Efforts in Falls Prevention

Local efforts in Japan to prevent falls among community-dwelling elderly trail those in North America and Europe, and also those at Japanese hospitals and other facilities.[13] There appear to be several reasons for this.

Here, we will address the modality of falls prevention with reference to a pioneering instance of a falls prevention program targeting community-dwelling elderly implemented by a collaboration of local government, researchers, and residents.[14]

**Prevention in a municipality, Miyagi prefecture**

With the cooperation of the municipal health and welfare department, the research group of Prof. Hiroshi Haga (then of Tohoku Bunka Gakuen University, currently of J.F. Oberlin University Graduate School) et al. conducted a community-

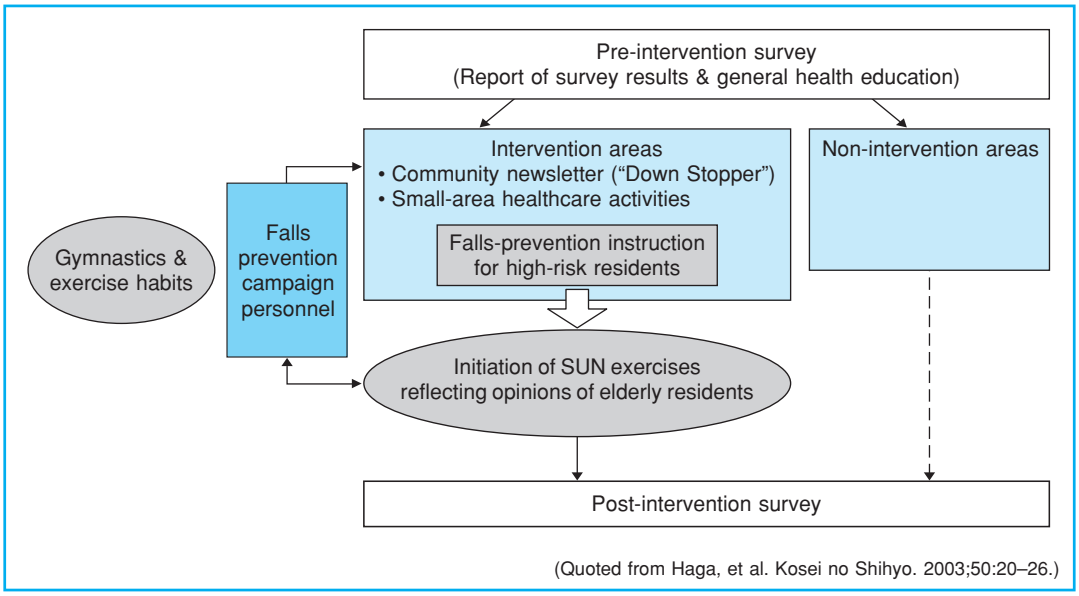


**Fig. 1 Course of intervention program**

SUN exercises are those devised with reference to views expressed by community-dwelling elderly residents who participated in the falls prevention instruction. Specifically, they are exercises that one elderly aged 75 and over may perform at home alone; the objective of the exercises was to maintain and improve leg muscle strength, body balance capacity, suppleness and other factors necessary in falls prevention.

**Table 2 Changes in incidence of falls, physical strength, and QOL pre- and post-intervention**

| | Intervention areas | | Non-intervention areas | |
|---|---|---|---|---|
| | Before (2000) | After (2001) | Before (2000) | After (2001) |
| Incidence of falls (%) | 26.5 | 23.9 | 23.2 | 25.4 |
| Grip strength (kg) | 20.7±7.8 | 20.3±7.5 | 22.0±7.9 | 21.3±7.6* |
| Forward flexion in long sitting position (cm) | 8.2±7.8 | 6.4±8.2** | 8.9±8.3 | 6.2±8.3** |
| Maximum walking speed (sec) | 8.3±2.1 | 8.7±2.7 | 8.3±2.1 | 9.3±2.7** |
| Single-leg standing, eyes open (sec) | 15.5±18.8 | 15.1±16.1 | 13.1±14.1 | 14.2±13.9* |
| Timed up & go test (sec) | 13.5±2.9 | 13.3±3.5 | 13.6±3.1 | 13.9±2.9 |
| Functional capacity (pts) | 10.5±2.8 | 10.0±3.3** | 10.5±2.5 | 10.2±3.1* |
| Motor fitness scale (pts) | 9.1±3.6 | 8.5±4.1** | 8.6±3.8 | 8.5±3.8 |
| Self-efficacy (pts) | 20.3±3.6 | 20.1±3.8 | 20.5±2.9 | 20.0±3.3* |
| Life satisfaction (mm) | 75.7±22.7 | 71.8±22.7* | 71.4±23.6 | 72.0±22.7 |

*$P<0.05$, **$P<0.01$ ($t$-test)

(Quoted from Haga H, et al. Kosei no Shihyo. 2003;50:20–26, partially modified)

based intervention program with the objectives of maintaining and improving the incidence of falls, physical strength, and subjective QOL of community-dwelling elderly aged 75 and over, primarily through instruction in physical exercise. (Fig. 1)[14]

The features of this study may be summarized in the following three points. First, the intervention programs involved all elderly residents in the areas where intervention was carried out, and control areas were also specified. A merit of this study is that, in contrast to conventional

study designs for individual intervention with a specified control, it meets the needs of program managers in future fall prevention programs conducted at the level of municipalities. Second, the study included the initiation of an exercise program reflecting the views of the elderly themselves, of fall prevention campaign personnel, and of municipal representatives, through the provision of fall prevention instruction. The voluntary participation of these people plays a role in enhancing motivation for the extension of the intervention program to other areas.

Third, the study assigned and trained the elderly volunteers (the fall prevention campaign personnel) as principal promoters of the program. The deployment of elderly volunteers is of deep significance in terms of shifting the elderly from recipients of services to providers of services. A further merit of the elderly volunteers is their motivation to maintain and improve their own physical strength.

One year of intervention resulted in a decline, albeit not significant, in the incidence of falls in the areas of intervention from 26.5% before to 23.9% afterwards, while the incidence of falls in areas of non-intervention increased from 23.2% to 25.4% (Table 2). In such indicators of physical strength as grip strength, forward flexion in long sitting position, and maximum walking speed, the decline was less in the areas of intervention than in the areas of non-intervention, and the former actually exhibited improvement in the timed up & go test. No differences were observed in such QOL indicators as self-efficacy and life satisfaction between two areas. Thus, this study suggests that intervention for falls prevention on total population of the elderly aged 75 and over is effective in maintaining physical strength and improving the incidence of falls.

## Conclusion

It is now 20 years since studies of falls among community-dwelling elderly in Japan started. Although epidemiological studies have produced a mass of evidence, it must be said that preventive efforts have only just gotten underway. With the introduction of long-term care insurance and the system focused on prevention, programs have been launched for the improvement of locomotive functions in the form of long-term care prevention programs inclusive of preventing falls and bone fractures. Over the past three years various programs have been conducted nationwide. Preventive efforts at the local level have generated track records, and one hopes that the effective programs will be implemented nationwide and that elderly may lead long and healthy lives.

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