

表Ⅱ-24 退院時転帰と1年後予後調査

退院転帰		1. 生存	2. 死亡	3. 不明	4. 空白	計
1. 軽快	10,098	7,254	580	1,186	1,078	10,098
2. 不変	538	300	92	61	85	538
3. 死亡	409	0	409	0	0	409
4. 不明と空白	1,205	722	76	142	265	1,205
計	12,250	8,276	1,157	1,389	1,428	12,250

表Ⅱ-25 合併症の有無と1年後の生存と死亡の比較

合併症数	人数	生存(人)	生存(%)	死亡(人)	死亡(%)	不明(人)	不明(%)
なし	834	614	73.6	31	3.7	189	22.7
あり	8,923	5,945	66.6	872	9.8	2,106	23.6
空白セル	2,493	1,725	69.2	217	8.7	551	22.1
合計	12,250	8,284	67.6	1,120	9.1	4,294	35.1

表Ⅱ-26 継続病院における死亡率比較

死亡患者数	H11	(%)	H12	(%)	H13	(%)	合計	(%)
男性	63	26.5	92	34.8	91	35.8	246	32.5
女性	162	68.1	167	63.3	160	63.0	489	64.7
空白セル	13	5.4	5	1.9	3	1.2	21	2.8
合計	238	100.0	264	100.0	254	100.0	756	100.0
患者全数(死亡比率%)	2402	(9.9%)	2380	(11.1%)	2717	(5.7%)	7499	(10.1%)

表Ⅱ-27 全病院の死亡率の比較

死亡患者数	H11	(%)	H12	(%)	H13	(%)	合計	(%)
男性	117	28.8	126	35.9	122	33.7	365	32.6
女性	274	67.3	219	62.4	237	65.5	730	65.2
空白セル	16	3.9	6	1.7	3	0.8	25	2.2
計	407	100.0	351	100.0	362	100.0	1120	100.0
患者全数(死亡比率%)	4,183	(9.7%)	3,726	(9.4%)	4,341	(8.3%)	12,250	(9.1%)

表Ⅱ-28 継続病院症例の術前・1年後のADL評価

ADLの変化	H11	(%)	H12	(%)	H13	(%)	合計	(%)
良変	402	16.7	548	23.0	729	26.8	1,679	22.4
不変	1,057	44.0	986	41.4	1,119	41.2	3,162	42.2
悪化	924	38.5	836	35.1	850	31.3	2,610	34.8
不明	19	0.8	10	0.4	19	0.7	48	0.6
合計	2,402	100.0%	2,380	100.0%	2,717	100.0%	7,499	100.0%

表 II-29 各年度全病院症例の術前・1年後の ADL 評価

ADLの変化	H11	(%)	H12	(%)	H13	(%)	合計	(%)
良変	666	15.9	1040	27.9	1385	31.9	3091	25.2
不変	1,753	41.9	1369	36.7	1666	38.4	4788	39.1
悪化	1,696	40.5	1265	34.0	1243	28.6	4204	34.3
不明	68	1.6	52	1.4	47	1.1	167	1.4
合計	4,183	100.0%	3726	100.0%	4341	100.0%	12250	100.0%

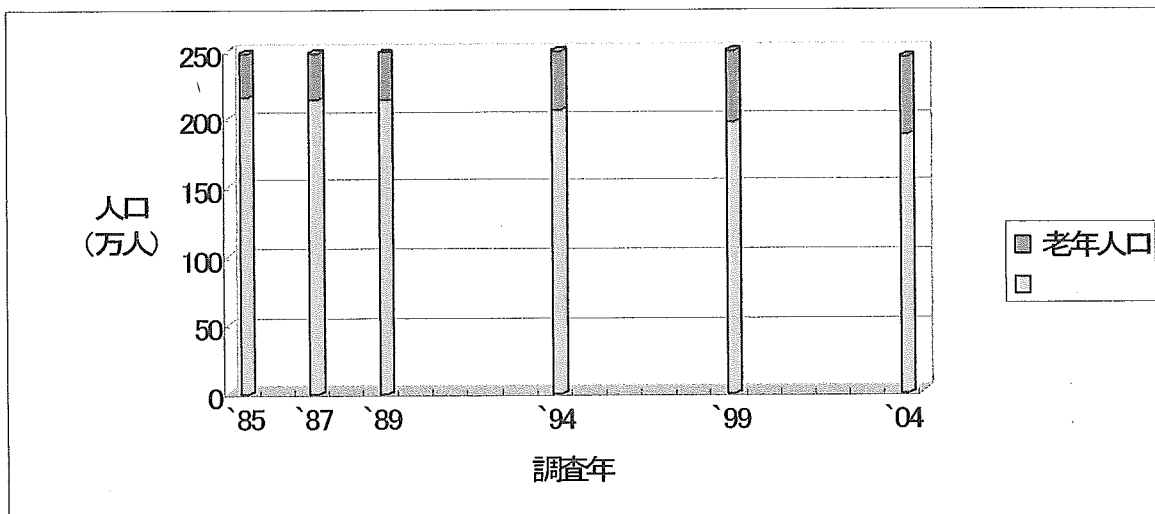
表Ⅲ-1 総骨折数および骨折型と発生率

	骨折数	発生率(10万人/年)
総骨折数	2421	98.8
男性	518	43.6
女性	1903	150.7
男女比	1:3.7	
骨折型		
頸部内側(内側)	837	34.2
転子部(外側)	1578	64.4
不明	6	
内外側比	1:1.9	

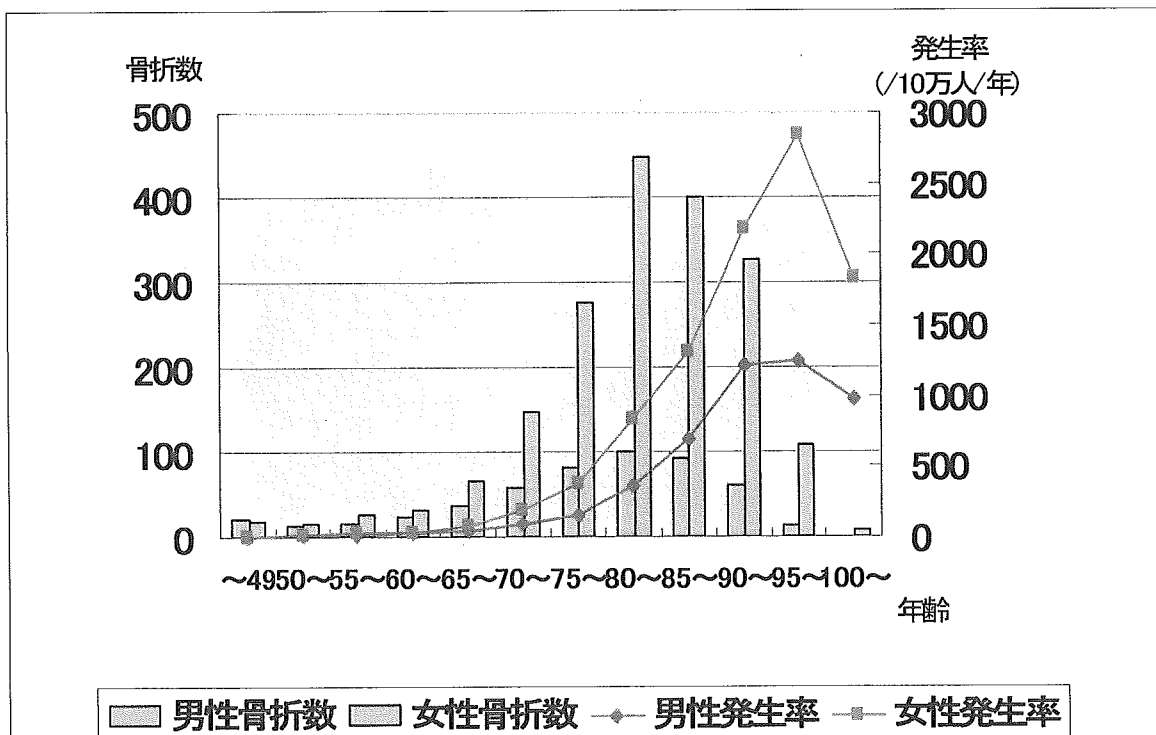
表Ⅲ-2 骨折数・平均年齢・発生率の推移

	'85	'87	'89	'94	'99	'04
骨折数	677	773	996	1468	1697	2421
男女比	1:2.7	1:2.4	1:2.8	1:2.9	1:3.2	1:3.6
平均年齢						
男性	67.5	70.4	71.4	74.4	75.5	77.8
女性	76.2	76.9	77.7	80.9	80.5	83.3
発生率	27.3	31.2	40.1	59.1	68.2	98.8

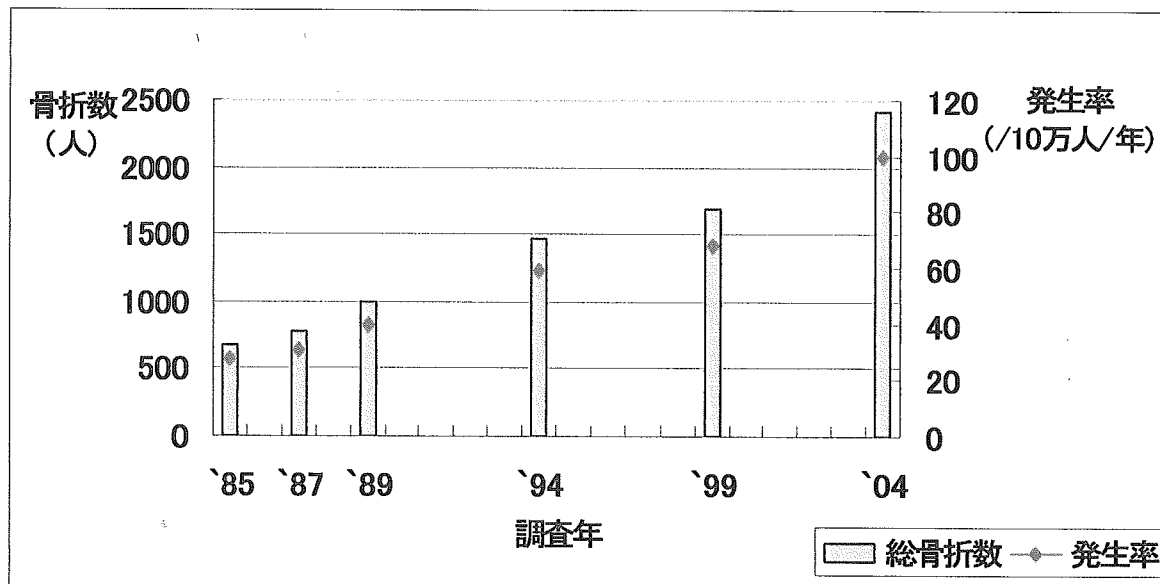
図Ⅲ-1 新潟県の総人口と老年人口割合



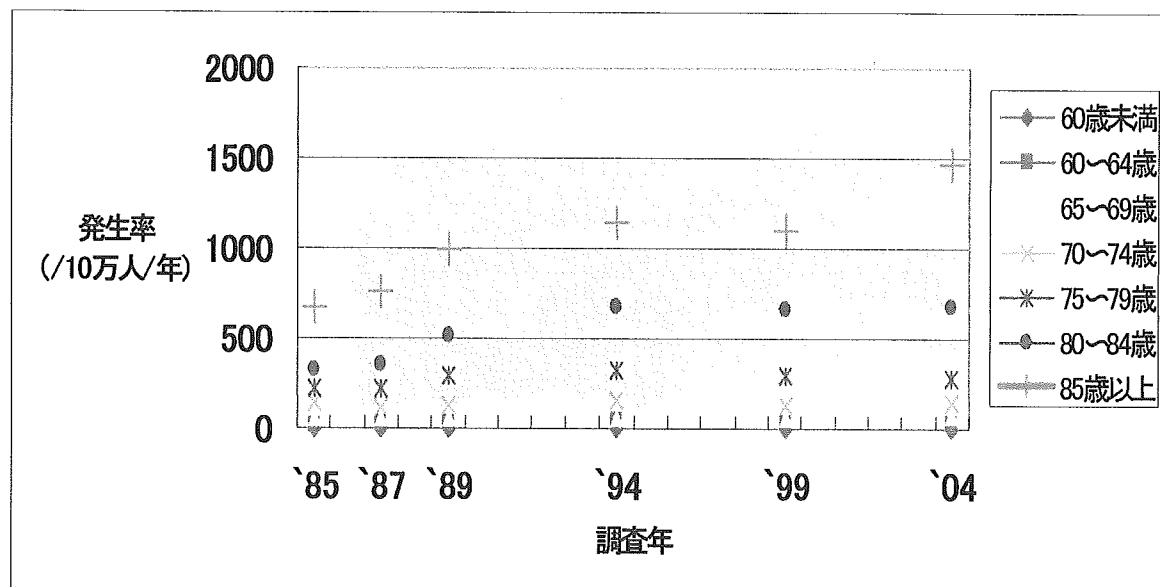
図Ⅲ-2 年齢階級別患者数と発生率



図Ⅲ-3 総骨折数と総発生率の推移

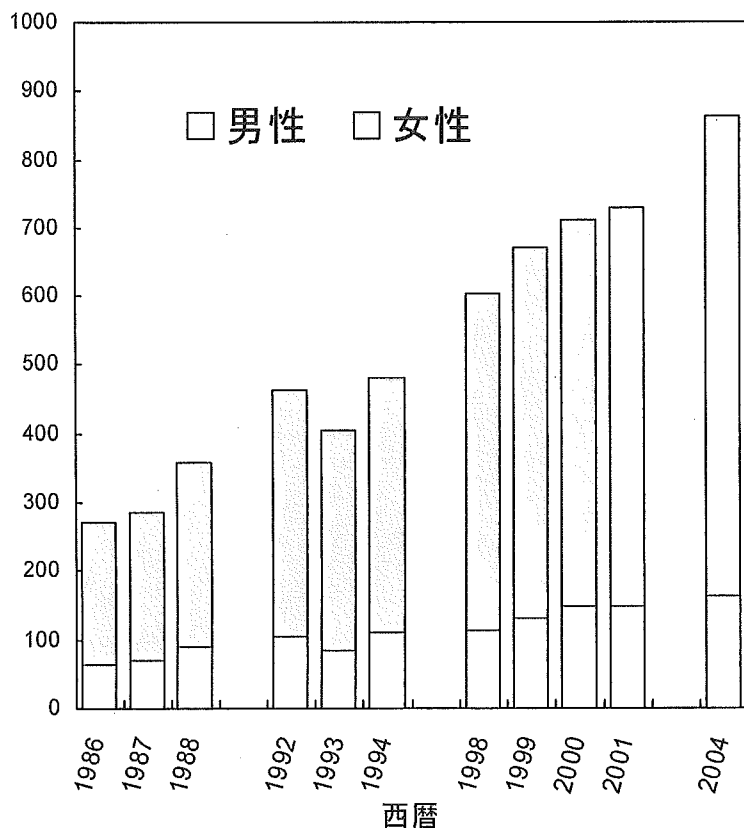


図Ⅲ-4 年齢階級別発生率の推移

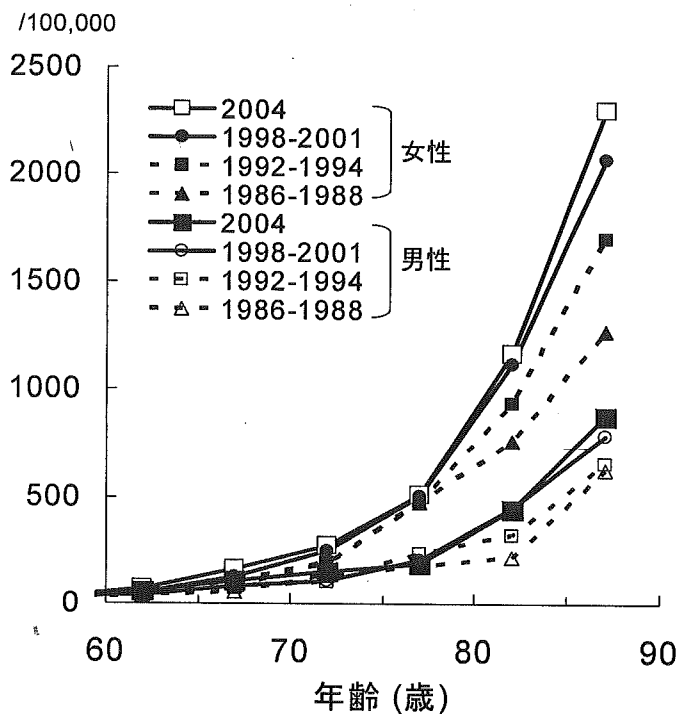


表Ⅲ-3 性・年齢階級別の患者数と発生率

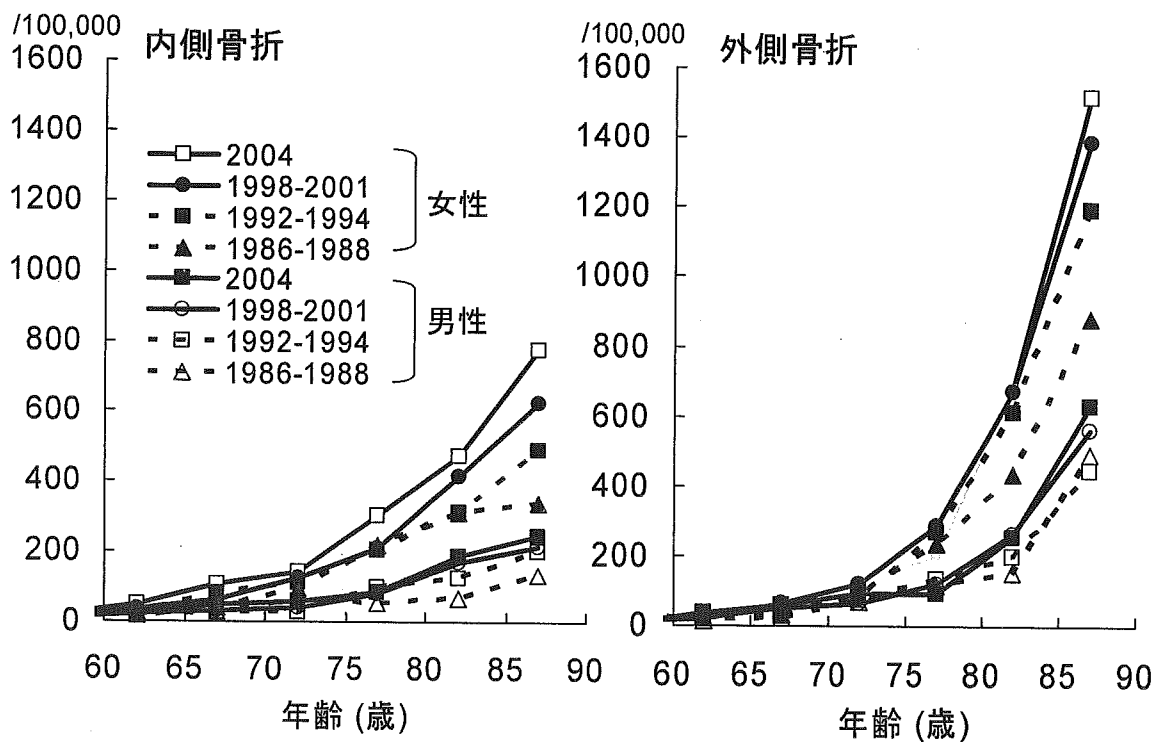
	患者数		人口		発生率	
	男性	女性	男性	女性	男性	女性
35-39 歳	0	1	16,592	16,931	0	6
40-44 歳	1	0	17,350	18,032	6	0
45-49 歳	5	1	20,047	20,002	25	5
50-54 歳	2	9	23,463	22,970	9	39
55-59 歳	3	7	22,444	22,147	13	32
60-64 歳	11	14	17,946	19,546	61	72
65-69 歳	18	32	16,258	19,544	111	164
70-74 歳	24	55	15,913	20,344	151	270
75-79 歳	24	97	12,941	19,095	185	508
80-84 歳	31	167	7,016	14,351	442	1,164
85 歳以上	43	318	4,911	13,834	876	2,299



図Ⅲ-5 鳥取県の大腿骨頸部骨折患者数推移



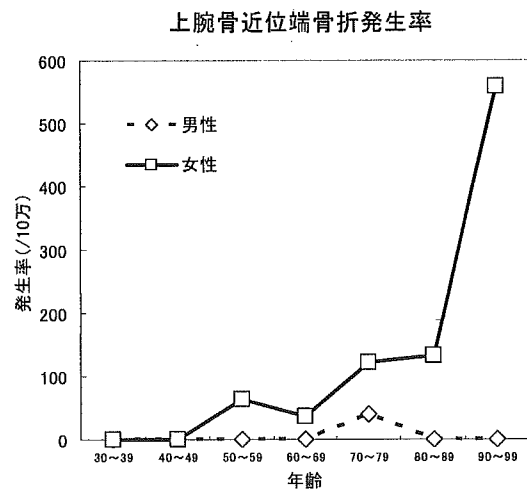
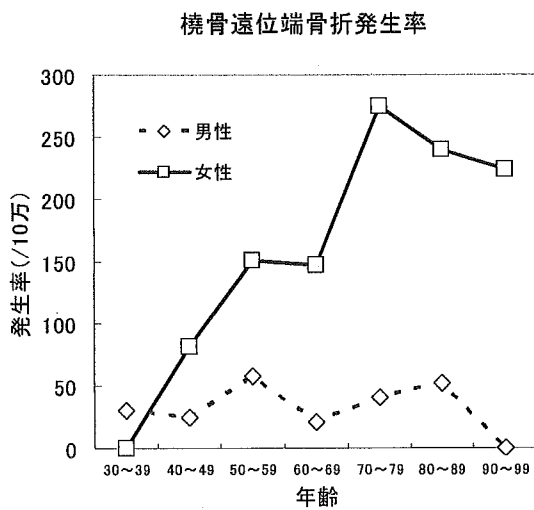
図Ⅲ-6 性・年齢階級別発生率の経年的推移



図Ⅲ-7 性・骨折型・年齢階級別発生率の経年的推移

表IV-1 上肢骨折患者数

年代	橈骨遠位端		上腕骨近位端	
	男性	女性	男性	女性
～9	2	0	0	0
10～19	7	2	1	0
20～29	0	0	0	0
30～39	1	0	0	0
40～49	1	3	0	0
50～59	3	7	0	3
60～69	1	8	0	2
70～79	2	18	2	8
80～89	1	9	0	5
90～99	0	2	0	5
計	18	49	3	23



図IV-1 性・年齢階級別発生率

研究成果の刊行に関する一覧表

雑誌

発表者氏名	論文タイトル名	発表誌名	巻号	ページ	出版年
Hagino H, et al	Increasing incidence of hip fracture in Tottori Prefecture, Japan: Trend from 1986 to 2001	Osteoporos Int	16	1963	2005
Committee for Osteoporosis Treatment of The Japanese Orthopaedic Association	Nationwide survey of hip fracture in Japan	J Orthop Sci	9	1	2004
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Increasing incidence of hip fracture in Tottori Prefecture, Japan: Trend from 1986 to 2001

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Abstract We conducted a survey of all hip fractures in patients 35 years old and over during 1998–2001 in Tottori Prefecture, Japan, and compared them with those reported previously. The survey found 604, 671, 710, 729 patients, in 1998, 1999, 2000, and 2001, respectively. The mean age- and gender-specific incidences (per 100,000 person-years) for men were 108.0, 209.0, 449.1, and 780.0 in the age groups of 70–74, 75–79, 80–84 and over 84, respectively, and those for women were 249.1, 505.8, 1,115.4, and 2,066.4, respectively. The expected numbers of patients in 1998 were 1.23 and 1.42 times those in 1986, and those in 2001 were 1.61 and 1.48 times those in 1986, for men and women, respectively, and the increases with time for both genders were significant. It was concluded that there was a significant increase in the incidence rates of hip fracture from 1986 to 2001.

Keywords Epidemiology · Hip fractures · Incidence · Osteoporosis · Trend

Introduction

Hip fracture presents a major health care problem in Japan and in many other developed countries. Previous epidemiological observations concluded that the incidence rates of hip fractures for Asian people including

Japanese are lower than those for Caucasians living in Northern Europe and North America [1–4]. Hispanic and black people in the USA as well as African people have lower incidence of hip fracture compared with US Caucasians [5–7]. However, a recent survey found an increase in the incidence of hip fracture in Asian populations [2, 8,9]. Chie reported higher incidence rates in Taiwan than in the Chinese population over the past 10 years [9], and it was pointed out that the hip fracture incidence rate increases with urbanization among Asian countries [4].

The shorter hip axis length among Asian people partially explains the lower hip fracture risk [10,11], and the prevalence of falls among Japanese being only half that of Caucasians offers another possible explanation for the lower incidence of hip fracture [12]. It was reported that some traditional Japanese lifestyle characteristics prevent hip fractures [13]. However, a westernized lifestyle has very rapidly become more common in Japan recently, which could elevate the incidence of hip fractures.

We previously performed a hip fracture survey in Tottori Prefecture and found that the incidence of hip fracture in Tottori Prefecture increased over the period from 1986 to 1994 [2]. The aims of this study were to investigate the hip fracture incidence rates in Tottori Prefecture from 1998 to 2001 and compare them with those reported previously.

Patients and methods

Data collection

Tottori Prefecture is located in mid-western Japan, and its population was 613,097 in 2001, with people aged 65 years and over accounting for 22.5% and those aged 80 years and over, 5.6%. We conducted a survey of all hip fractures in patients 35 years old and over during 1998–2001 in all hospitals in Tottori Prefecture. In Tottori Prefecture, there were 30 hospitals that had a

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department of orthopedic surgery or general surgery during the observation period, and survey registration was performed each year in all these hospitals by the doctors and the staff of each hospital according to hospital records. Registration information included name, gender, age, place of residence, date of the fracture, type of fracture (neck or trochanteric) and the treatment. Patients residing in other prefectures were excluded. Duplication of cases was checked by the patients' names and addresses. Completion of registration was confirmed by interviewing doctors or making telephone calls, and investigators were sent from Tottori University to hospitals, if necessary, to complete the registrations.

To compare data with those reported before, we investigated the methods of collection at the three hospitals with the most patients (top three), which cover one-third of the total patients in this prefecture. We confirmed that the methods of registration of patients with hip fracture were consistent from 1986 to 1988, from 1992 to 1994, and from 1988 to 2001 at those three hospitals. All patients' data were collected based on hospital records including surgical records. The number of patients increased consistently from 1986 to 2001 and the increases were 3.0-fold (22 and 67), 4.0-fold (19 and 76), and 4.5-fold (21 and 95), respectively, at the three hospitals.

Calculation of the incidence

The patients were divided into groups according to age (subdivided into 5-year increments), gender, and fracture type. The age- and gender-specific incidence rates (per 100,000 person-years) were calculated based on the population of Tottori Prefecture in each year. A national census is undertaken on October 1 every 5 years in Japan, and it was performed in 2000 during the observation period. The age- and gender-specific population for each survey year was estimated by the Bureau of Statistics of the Tottori Prefecture government according to its resident registration records.

Statistical methods

To determine the recent incidence trend, a test of trends of proportions in quantitatively ordered samples was used to analyze the changes of incidence [14]. The age- and gender-specific incidence rates (per 100,000 person-years) during 1986–1988 and 1992–1994, which we reported before [2], were used for this analysis. The expected number of patients, age-adjusted to the population structure of 1986 in Tottori Prefecture (35 years and over), was calculated from the age- and gender-specific incidence rates in each observation year. Then, the values of the chi-square for overall and slope were examined.

The monthly variation in the number of patients was tested by the Friedman test.

$p < 0.05$ was regarded as significant.

Results

Number of patients

Registration was performed in all hospitals during the whole observation period; as a result, this survey covered all patients with the studied fractures. The survey found 604 (114 men and 490 women), 671 (130 men and 541 women), 710 (150 men and 560 women), 729 (150 men and 579 women) patients, in 1998, 1999, 2000, and 2001, respectively.

Dividing into the fracture types, there were 228 neck and 362 trochanteric (undetermined 14), 243 neck and 416 trochanteric (undetermined 12), 259 neck and 422 trochanteric (undetermined 29), and 293 neck and 428 trochanteric (undetermined 8), in 1998, 1999, 2000, and 2001, respectively. Concerning the fracture site, there was no significant difference between the numbers of fractures on the right or left (by chi-square test).

Age- and gender-specific incidence

The age- and gender-specific incidences (per 100,000 person-years) for both genders increased exponentially after 70 years of age (Table 1, Fig. 1). Dividing into the fracture types, those for neck fractures averaged for 4 years (from 1998 to 2001) were 42.0 for men and 123.4 for women, 78.8 and 209.6, 169.7 and 413.4, and 213.0 and 625.2, in the age groups of 70–74, 75–79, 80–84, and over 84, respectively (Table 2). Those for trochanteric fractures were 64.4 for men and 122.1 for women, 122.7 and 287.5, 262.1 and 671.1, and 560.4 and 1,388.2, respectively.

The recent incidence trend

The age- and gender-specific incidence rates between 1986 and 2001, averaged for 3-year or 4-year observation periods, increased among patients 80 years old and over for both genders (Fig. 1). The expected numbers of patients in 1992 were 1.39 and 1.34 times those in 1986 for men and women, respectively; those in 1998 were 1.23 and 1.42 times, and those in 2001 were 1.61 and 1.48 times those in 1986, for men and women, respectively (Table 3). The trend test for the increase in the incidence rates in each year showed a significant increase with time for both genders. (The time-trend data analysis reported in Table 3 is based on individual year data and not on 3-year or 4-year observation periods as in Fig. 1.)

Dividing into the fracture types, the age- and gender-specific incidence rates between 1986 and 2001 averaged for 3-year or 4-year observation periods increased with time for both neck and trochanteric fractures in both genders (Table 2). The expected numbers of patients for

Table 1 Age- and gender-specific incidence of hip fracture in Tottori Prefecture, Japan. Data are incidence rates per 100,000 person-years

Age group (year)	Men				Women				Average	
	1998	1999	2000	2001	1998	1999	2000	2001	Men	Women
35-39	0	0	5.8	6.1	0	0	0	0	3.0	0
40-44	4.8	5.0	10.2	26.4	0	0	10.2	10.5	11.6	5.2
45-49	11.9	4.2	8.7	9.0	8.2	21.7	4.5	9.3	8.5	10.9
50-54	14.2	4.4	24.4	33.8	14.4	13.5	8.3	7.8	19.2	11.0
55-59	34.3	32.6	21.6	63.0	26.1	76.1	15.4	27.5	37.9	36.3
60-64	28.0	58.4	41.4	47.4	72.3	25.1	72.1	52.0	43.8	55.4
65-69	61.4	118.7	91.4	62.8	171.7	98.6	108.7	129.0	83.6	127.0
70-74	93.2	122.7	95.8	120.3	244.2	165.7	268.0	318.4	108.0	249.1
75-79	140.4	212.0	330.7	152.9	467.5	435.4	566.2	554.2	209.0	505.8
80-84	352.3	321.0	505.5	617.8	1,015.6	1,337.2	1,087.7	1,021.2	449.1	1,115.4
85-	1,003.7	719.1	774.5	622.9	1,932.8	2,224.5	2,108.9	1,999.5	780.0	2,066.4

each fracture type for women in 1992 were 1.32 and 1.34 times those in 1986 for neck and trochanteric fractures, respectively. Those in 1998 were 1.39 and 1.42 times those in 1986, and those in 2001 were 1.48 and 1.49 times those in 1986 (Table 3) for neck and trochanteric fractures, respectively. The trend test showed a significant increase with time for women in both fracture types but no significant increase for men.

Monthly variation

The highest number of fractures occurred in October; the second-highest number occurred in January. The lowest number of fractures occurred in July and the

second-lowest occurred in June (Fig. 2). There was a significant monthly variation ($p < 0.05$, by Friedman test).

Discussion

This study demonstrated that the age-adjusted incidence rates of hip fracture for both genders from 1998 to 2001 were significantly higher than those from 1986 to 1988 or those from 1992 to 1994 in Tottori Prefecture. Comparing the recent data concerning the incidence of hip fractures within Japan [15,16], the incidence rates were similar to our results, suggesting that the incidences in this study properly represent the Japanese population.

The secular trends in the incidence of hip fractures are variable between observation periods or geographic areas according to previous studies. Epidemiological surveys before 1990 in Europe in most cases showed that the incidence of hip fractures was increasing [17-21]; however, data in the 1990s from Northern Europe [22-24], North America [25], and Australia [26] indicated that the increase had leveled off or stopped. In East Germany, a steep increase since reunification was reported in the incidence of hip fracture, suggesting a significant influence of Western lifestyle on hip fracture incidence [27].

Most reports from the Asian area indicated an increase in the incidence of hip fracture with time [2, 16, 28,29]. In Singapore hip fracture rates from 1991 to 1998 for women were five times higher than corresponding rates in the 1960s [8], and in Hong Kong those for women 80 years old and over in 1995 were three times higher than corresponding rates in the 1960s. However, the trends of the last decade in these two areas are different from those before [30]. The increases were only 1.1 times in Singapore in the 1990s and 1.4 times in Hong Kong from 1985 to 1995. The increase in the incidence rate in our observations, which was 1.4 times from 1986 to 1998 (Table 2), were very close to these findings. From these points of view, the age-specific incidences of hip fracture among developed and urbanized Asian

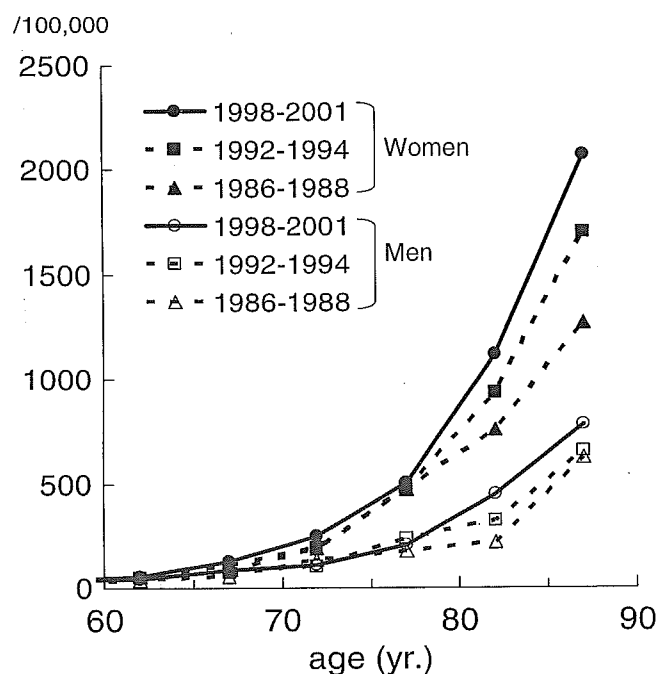


Fig. 1 The age- and gender-specific incidence rates (per 100,000 person-years) of hip fracture between 1986 and 2001 (The incidence rates during 1986-88 and 1992-94, which we reported before (Hagino H, 1999), were used for comparison)

Table 2 Age- and gender-specific incidence of neck and trochanteric fracture in Tottori Prefecture, Japan. Data are incidence rates per 100,000 person-years. Incidence rates for 1986-88 and 1992-94 were reported earlier (Hagino H, 1999)

Age group (years)	Men						Women					
	Neck			Trochanter			Neck			Trochanter		
	1986-1988	1992-1994	1998-2001	1986-1988	1992-1994	1998-2001	1986-1988	1992-1994	1998-2001	1986-1988	1992-1994	1998-2001
35-39	0	1.7	3.0	6.4	0	0	0	0	0	0	0	0
40-44	5.0	1.4	6.6	7.9	7.7	3.8	0	1.4	5.2	1.6	1.4	0
45-49	1.8	4.7	3.2	3.6	4.9	5.3	0	4.8	7.7	1.7	1.5	1.0
50-54	8.4	3.5	7.2	10.1	11.0	10.8	7.8	3.5	6.6	6.1	6.9	4.4
55-59	11.5	12.3	19.7	14.8	18.2	18.1	16.3	27.5	23.3	7.4	9.7	12.9
60-64	17.0	20.9	20.4	15.0	29.6	23.4	26.6	25.8	37.6	25.0	24.2	16.5
65-69	26.1	28.1	29.8	22.9	49.6	52.4	42.3	80.9	62.4	34.4	26.8	63.5
70-74	64.1	28.9	42.0	67.4	71.9	64.4	95.5	109.4	123.4	93.1	85.4	122.1
75-79	54.9	96.7	78.8	115.1	134.8	122.7	219.4	206.7	209.6	237.8	268.0	287.5
80-84	67.7	125.0	169.7	151.5	197.8	262.1	310.7	311.5	413.4	436.1	611.8	671.1
85-	132.9	198.7	213.0	489.3	445.2	560.4	338.9	489.6	625.2	881.7	1,191.9	1,388.2

areas seem to have leveled off in the last decade, although small increases still exist.

The increase in risk factors of fractures might contribute to the increase in fracture incidence. Two studies were performed to elucidate risk factors for hip fracture among the Japanese population [13,31]. In one of them [13], a case-control study on hip fracture was performed and found that some Westernized lifestyle characteristics such as sleeping in a (Western-type) bed increased the risk of hip fractures, and traditional Japanese lifestyle factors such as drinking Japanese tea were effective in preventing hip fractures. Recently, we reported that one of the significant preventive factors for distal radius fractures among Japanese was the use of a futon (as opposed to bed use), and we speculated that futon use maintains physical activity resulting in a reduced risk of falls [32]. The decrease in physical activity of a Westernized lifestyle is one of the possible explanations for the increase in fracture incidence among Japanese. Another explanation might be a greater proportion of seniors with poor health because of other conditions under treatment, with the result that people are living longer at a time when their bones are considerably weakened [2].

Several studies have demonstrated seasonality in hip fractures [33-36], while another failed to find it [37]. In the previous studies which found seasonal variation, the incidence of hip fracture was higher in the winter than the summer period. A nationwide survey in Japan also found that the number of patients per month was highest in January and lowest in June or July, showing a significant monthly variation [38]. Although our previous study failed to find such a variation [2], there was a significant monthly variation in the number of hip fracture patients in the present study, with a lower incidence during the summer months than during winter months, supporting previous studies. Since about 70% of patients sustained fractures indoors [38], weather conditions such as ice or snow have only little impact on fracture occurrence. It is possible that elderly patients have poorer coordination in winter and are clumsier due to extra layers of clothing, which may lead to falls [36]. Cold weather is associated with lower blood pressure, which also increases the risk of falls [34]. A low level of vitamin D in winter may cause the higher incidence of fracture, since the low vitamin D level in winter results in not only diminished bone mineral density but also diminished muscle strength, increasing falls [39].

Our study has limitations concerning data collection. All hospitals but one in Tottori Prefecture that have a department of orthopedic surgery or general surgery have doctors related to Tottori University, and this circumstance affects the validity of the survey. To compare the present data with those reported before, we checked on the methods of collection at the top three hospitals in terms of patient numbers and found the method of registration was consistent during the observation periods. We also observed steady increases in the number of registered patients in these hospitals. It is most likely that the incidences each year were

Table 3 Test of trends of proportions in number of patients with hip fractures per annum (35 years and over). Data are the expected number of patients adjusted for the age- and gender-specific incidence in each year, adjusted by the population structure of 1986.

Population ages 35 and over was 154,774 for men and 183,157 for women in 1986. Incidence rates for 1986–88 and 1992–94 were reported earlier (Hagino H, 1999)

	All hip fractures		Neck fractures		Trochanteric fractures	
	Men	Women	Men	Women	Men	Women
1986	63.0	209.0	22.0	87.0	39.0	119.0
1987	68.5	205.6	25.1	86.4	43.4	116.4
1988	85.1	245.4	32.3	102.5	51.0	133.9
1992	87.4	281.1	34.9	114.9	51.5	159.8
1993	71.0	237.7	22.2	100.8	48.1	136.2
1994	88.4	265.9	32.5	109.3	55.9	156.0
1998	77.3	295.9	29.1	121.2	45.8	169.3
1999	86.0	307.3	32.1	121.0	53.2	180.3
2000	99.2	309.8	31.8	124.2	62.7	173.0
2001	101.3	309.1	47.7	129.0	52.9	176.9
χ^2 overall	17.4	55.3	16.1	18.8	8.0	34.0
	<0.05	<0.001	n.s.	<0.05	n.s.	<0.001
χ^2 slope	9.5	48.1	5.9	16.5	3.5	30.2
	<0.01	<0.001	<0.05	<0.001	n.s.	<0.001

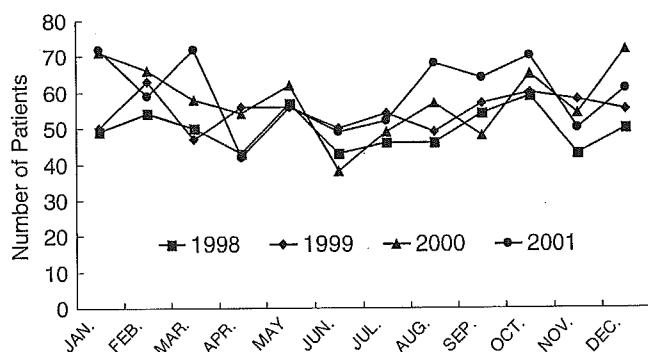


Fig. 2 Monthly variation in number of patients with hip fractures

comparable; however, data collection bias based on hospital records in each hospital cannot be discounted. Furthermore, hip fracture patients resident in Tottori Prefecture and treated outside this Prefecture could have missed the registration. From the geographical features of Tottori Prefecture, all patients with hip fracture must be treated at a hospital within the Prefecture, but those who were injured outside the Prefecture may have missed registration, although the number of such patients would be very small.

In conclusion, the incidence rates of hip fracture from 1998 to 2001 increased compared with those from 1986 to 1988 or from 1992 to 1994. It is estimated that the population aged 65 years and over will account for 23% of the total population in Japan in 2010, rising to 30% in 2030. Based on the age- and gender-specific incidence observed in the current study, the total number of hip fracture patients in Japan is forecast to be 153,000 per year in 2010, and 238,000 in 2030. Strategies including prevention and treatment of osteoporosis and prevention of falling, and maintenance of physical activities among the elderly by changing lifestyle will be extremely

important in order to reduce the social burden of hip fractures in the future.

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Original articles

Nationwide survey of hip fractures in Japan

Committee for Osteoporosis Treatment of The Japanese Orthopaedic Association

Abstract To elucidate the current status of hip fracture incidence and treatment in Japan, a tally of hip fractures in patients from 1998 to 2000 was conducted in Japanese Orthopaedic Association-related hospitals. Response rates were from 40.5% to 55.6% in each observation year. The survey found a total of 110747 new hip fractures aged 35 years old and over during the survey years. Age- and gender-specific number of patients increased with age and peaked at the age of 80–84 years, then leveled off after 85 years of age. The number of patients with femoral neck fractures exceeded that with trochanteric fractures before 75 years of age, and these figures became inverted thereafter. More left hips were fractured than right in all survey years; however, the difference was not significant. The most common cause of hip fractures was a simple fall; 68.8% sustained fractures indoors, and there was a significant monthly variation. Ninety-three percent of the patients with femoral neck fractures and 94% of the patients with trochanteric fractures were treated surgically, and about three fourths were treated with hemiarthroplasty among patients with femoral neck fractures. The mean hospitalization period was 56.4 days during the observation period.

Key words Hip fracture · Epidemiology · Treatment

Introduction

The rapid increase in the number of osteoporotic patients and osteoporosis-related fractures now presents a major healthcare problem in many developed countries. There have been several epidemiological studies of hip fractures in Japan, and the age- and gender-specific incidence of hip fractures was reported to be one third to one half that for Caucasians living in North America or Northern Europe.^{6,10,11} However, with the rapid increase in the elderly population, the number of hip fractures in Japan is projected to be more than double in 2025,⁶ and it is also predicted that 26% of all hip fractures occurred in Asia in 1990, whereas this figure could rise to 37% in 2025 and to 45% in 2050.⁴

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There is no nationwide report covering the status of fracture occurrence including fracture type, cause of fracture, and treatment, including selection of the treatment and duration of hospitalization, in Japan. To elucidate the characteristics of hip fracture and the current status of its treatment in Japan, the Japanese Orthopaedic Association conducted a nationwide hip fracture survey from 1998 to the present. This report represents the findings between 1998 and 2000.

Patients and methods

Data collection

A tally of all hip fractures in patients from 1998 to 2000 was conducted in Japanese Orthopaedic Association (JOA)-authorized hospitals and in Japanese Clinical Orthopaedic Association (JCOA) hospitals. There were 2270, 2264, and 2312 JOA-authorized hospitals and 1529, 1430, and 1512 JCOA hospitals in 1998, 1999, and 2000, respectively.

Registration forms were sent to these hospitals by mail, and registration was performed by doctors at each hospital according to their hospital records. The survey was performed twice, in the first half and latter half of the year, for 1998, and once each in 1999 and 2000. Registration information included name (initials), gender, date of birth, date of fracture, date of the first visit to hospital, fracture site, fracture type, place the fracture occurred, cause of the injury, treatment, and duration of the hospitalization. Duplication of cases was checked by the patients' initials and the date of birth.

Cause of injury was divided into six categories: "in bed," "simple fall," "fall on stairs," "traffic accident," "unremembered," and "unknown." The term "in bed" indicates a fracture that occurred when lying in bed, "simple fall" describes falling from a standing height or from bed, "unremembered" is when patients did not remember the injury, and "unknown" is when the information could not be obtained from patients because of some difficulty, such as dementia. In addition to these six categories, we surveyed fractures described as "care fracture," which occurred during care activities of bedridden patients such as diaper changing and bed bath,

and this type of fracture was included as a fracture occurring "in bed."

Duration of the hospitalization was calculated in the hospital where the patients were treated just after the injury, and data of hospitalization duration from the second or the third hospital were omitted from the analysis.

Statistical methods

We compared data between the two groups with Mann-Whitney tests. Seasonal variations were tested with the Friedman repeated measures analysis of variance on ranks. Proportion in patients between the groups was tested by chi-square test. $P < 0.05$ was considered statistically significant.

Results

Response rates from JOA-authorized hospitals were 53.7%, 55.6%, and 46.0%, in 1998, 1999, and 2000, respectively (Fig. 1); those for JCOA hospitals were 40.5%, 54.4%, and 48.5%, respectively. The survey found a total of 110747 new hip fractures at ages 35 years and over during the survey years (Table 1). The number of women was 3.7 fold that of men.

Age- and gender-specific number in patients

Age- and gender-specific number of patients increased with age and peaked at the age of 80–84 years, then leveled off after 85 years of age (Fig. 2). This pattern was the same for both genders; however, the number of women rose to more than twice that of men among patients over 65 years of age. There were 233 patients

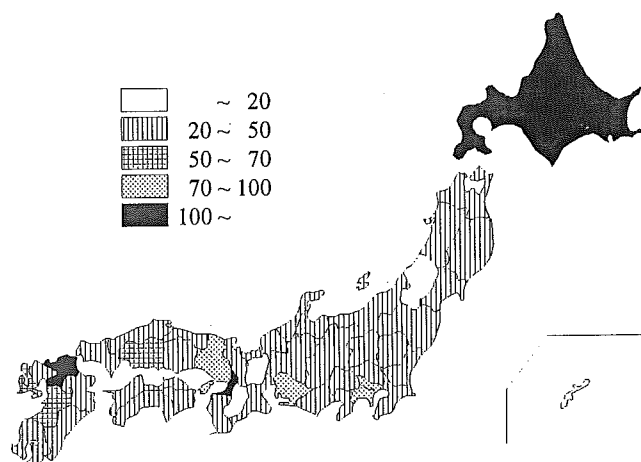


Fig. 1. Numbers of Japanese Orthopaedic Association (JOA)-authorized and Japanese Clinical Orthopaedic Association (JCOA) hospitals that responded to the survey in 2000

aged 100 years old and over during the 3-year survey period.

Dividing by fracture types, 61 632 were trochanteric fractures, 47 853 neck fractures, and 1262 unclassified fractures during the 3-year survey period. Age- and fracture type-specific number of patients for both fracture types is shown in Fig. 3. The number of patients with femoral neck fractures exceeded that with trochanteric fractures before 75 years of age, and these figures became inverted thereafter. The ratio of trochanteric/neck fracture patients was 1.5, 1.9, 2.2, and 2.5 at ages 80–84, 85–89, 90–94, and 95–99, respectively.

Fracture site

Right hips were fractured in 53 713 patients, left hips in 56 090 patients, and both in 895 (0.8%) patients (laterality was not indicated in 944). More left hips were fractured than right in all survey years; however, the difference in left and right sides was not significant by χ^2 test (Table 2).

Cause of the fracture

The most common cause of hip fractures was a simple fall, comprising 74.0% of the total cause (Table 3). In

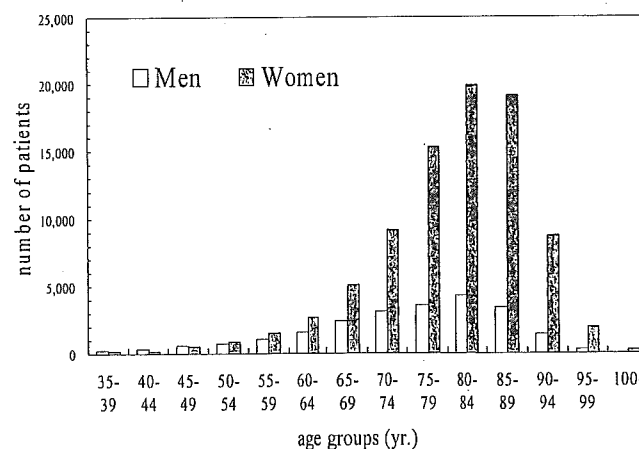


Fig. 2. Age- and gender-specific numbers of patients with hip fractures increased with age and peaked at the age of 80–84 years, then leveled off after 85 years of age

Table 1. Registered patients with hip fractures at ages 35 years and over

Survey year	Total	Male	Female	Neck	Trochanteric
1998	36226	7761	28275	15767	20111
1999	40069	8556	31253	17208	22362
2000	34452	7351	26889	14878	19159
Total	110747	23668	86417	47853	61632

Data show number of patients

Table 2. Injured side in hip fractures

	1998	1999	2000	Total
Right	17 552	19 375	16 786	53 713
Left	18 379	20 253	17 458	56 090
Both	153 (0.4%)	378 (1.0%)	364 (1.1%)	895 (0.8%)
Not indicated	295	441	208	944

Table 3. Causes of hip fractures

	Total	<90 years old	≥90 years old
Simple fall	74 814 (74.0%)	64 425 (72.8%)	10 389 (82.1%)
Traffic accident	10 021 (9.9%)	9 609 (10.9%)	412 (3.3%)
Fall on stairs	8 086 (8.0%)	7 402 (8.4%)	684 (5.4%)
In bed	2 238 (2.2%)	1 866 (2.1%)	372 (2.9%)
Not remembered	1 507 (1.5%)	1 333 (1.5%)	174 (1.4%)
Unknown	4 446 (4.4%)	3 826 (4.3%)	620 (4.9%)
Care fracture ^a	175 (0.27%)	139 (0.24%)	36 (0.42%)

Data show number of patients

^a Occurred during the care of bed-ridden patients, such as changing diapers (data from 1999 and 2000)

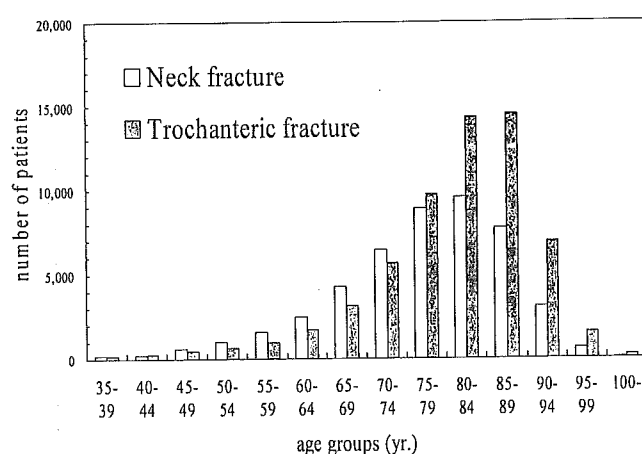


Fig. 3. Age- and fracture type-specific numbers of patients with hip fractures. The number of patients with femoral neck fractures (white bars) exceeded that with trochanteric fractures (shaded bars) before 75 years of age, and these figures became inverted thereafter

patients aged 90 years old and over, a simple fall was the cause in more than 80%.

Of the patients surveyed, 71 391 (68.8%) sustained fractures indoors and 32 447 (31.2%) outdoors. Among patients 90 years old and over, 84.9% of fractures occurred indoors.

Monthly variation

The number of patients per month was the highest in January, and the lowest in June in 1998 and 1999 and in July in 2000 during the 3 observation years (Fig. 4).

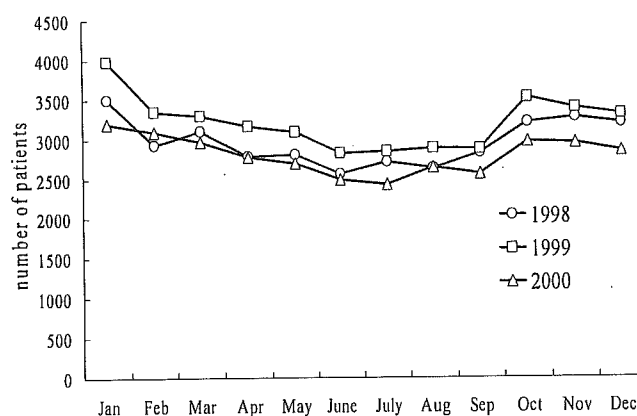


Fig. 4. The number of patients with hip fractures per month was the highest in January and the lowest in June 1998 (circles) and 1999 (squares) and in July 2000 (triangles) during the 3 observation years. There was a significant difference in monthly variation ($P < 0.01$)

There was a significant difference in monthly variation ($P < 0.01$).

Selected treatment and duration of hospitalization

Among the patients with neck fracture, 43 854 (93.3%) were treated surgically and among the patients with trochanteric fracture 57 302 (94.1%) were treated surgically (Table 4). Among patients with femoral neck fractures, about three fourths were treated with hemiarthroplasty.

The mean hospitalization period was 54.8, 58.5, and 55.9 days in 1998, 1999, and 2000, respectively (Table 5).

There was no significant difference in hospitalization period between femoral neck fracture patients and trochanteric fracture patients; however, it was longer in patients treated by osteosynthesis than among those treated by hemiarthroplasty. The hospitalization period was longer in patients aged under 90 years old than in those 90 years old and over.

Discussion

This study is the first epidemiology investigation conducted among all hospitals related to the JOA and JCOA in Japan. Patient registration was performed by approximately half those hospitals, and 110729 hip fractures, were analyzed. According to the reports concerning hip fracture incidence,^{6,10,11} about 90000 new hip fractures have occurred annually throughout the whole of Japan; therefore, this survey covered about 40% of those patients.

This study demonstrated that the number of women patients was 3.7 times that of men, and the age-specific number of patients in their eighties comprised 43% of the total patients. It is well known that the incidence of hip fractures increases exponentially over the age of 80; however, the actual number of patients was highest between 80 and 84 years old. In this study, more trochanteric fractures than femoral neck fractures occurred among patients over 75 years old, and as age increased the trochanteric/neck ratio also increased. Because trochanteric fractures have a closer relationship with low bone mass than do femoral neck frac-

tures,⁹ trochanteric fractures occur more often than femoral neck fractures among the more elderly population.

Several studies have demonstrated seasonality in hip fractures^{7,8} whereas others contradict this finding.¹² This study clearly demonstrated an increase in the number of patients with hip fractures in December, January, and February, showing a significant difference. Because this study also showed that about 70% of patients sustained fractures indoors, freezing weather or snow has little impact on the fracture occurrence. It is reported that low blood pressure caused by low temperature and lack of vitamin D during the winter season increases bone fragility and decreases muscle strength, increasing the risk of fall.⁷ These are possible explanations for the high incidence of hip fracture during the winter season.

There have been no reports concerning the cause of hip fractures, among the Japanese population. Simple falling was the most common cause of hip fractures and more fractures occurred indoors than outdoors in the present study, which is consistent with the previous observation.³ In addition to this information, we surveyed "care fracture," which occurred during the care activity of bedridden patients such as diaper changing (surveyed in 1999 and 2000). Fractures at the distal metaphysis and diaphysis of the femur as well as the proximal femur occurred during these activities. Although these injuries comprised only 0.27% of the total hip fractures, it is sufficient to alert people who care for bedridden elderly patients.

This was the first report to clarify the current status of treatment for hip fractures in Japan. Hip fractures are usually treated surgically, except in special cases in which surgical treatment is not needed or cannot be performed. This survey found that surgical treatment was selected in 94% and conservative treatment in 6%; accordingly, 86000 hip fractures annually are treated surgically in Japan. It is reported that the treatment cost for hip fracture is ¥1400000 per person at the first hospital, including all fees during a hospitalization in Japan.⁵ Therefore, hip fracture treatment costs about ¥130000000000 per year for all hip fractures; however,

Table 4. Selected treatment for patients with hip fractures

Treatment	Neck	Trochanteric
Conservative	3 128 (6.7%)	3 582 (5.9%)
Surgical	43 854 (93.3%)	57 302 (94.1%)
Hemiarthroplasty	32 364 (73.8%)	1 055 (1.8%)
Osteosynthesis	11 180 (25.5%)	55 819 (97.4%)
Not indicated	310 (0.7%)	428 (0.7%)

Data show number of patients

Table 5. Duration of hospitalization of patients with hip fractures

	1998*	1999**	2000**
Total	54.8 (1-353)	58.5 (1-363)	55.9 (1-360)
Trochanteric	54.8	58.4	56.0
Neck	56.0	58.6	55.8
Hemiarthroplasty	55.9	58.3	56.7
Osteosynthesis	61.2	63.6	58.3
<90 years old	56.0	59.1	56.2
≥90 years old	49.4	54.1	53.0

Data are mean days of hospitalization

*The survey was performed twice, in the first half and latter half of the year

**The survey was performed once