

# Impending Epidemic

## — Future Projection of Heart Failure in Japan to the Year 2055 —

Yuji Okura, MD; Mahmoud M. Ramadan, MD; Yukiko Ohno, MD; Wataru Mitsuma, MD;  
Komei Tanaka, MD; Masahiro Ito, MD; Keisuke Suzuki, MD\*; Naohito Tanabe, MD\*\*;  
Makoto Kodama, MD; Yoshifusa Aizawa, MD

**Background** The future burden of heart failure in Japan was projected to 2055 in order to prospectively estimate of the number of these patients.

**Methods and Results** The statistics are based on prevalence data of left ventricular dysfunction (LVD) in Sado City using the Sado Heart Failure Study (2003) and population estimates from the Japanese National Institute of Population and Social Security Research Report (2006). The number of Japanese outpatients with LVD was 979,000 in 2005, and is predicted to increase gradually as the population ages, reaching 1.3 million by 2030.

**Conclusion** LVD is expected to precipitate a future epidemic of heart failure in Japan. (*Circ J* 2008; 72: 489–491)

**Key Words:** Epidemiology; Future projection; Heart failure; Japan

**H**eart failure (HF) is a major and growing public health problem in developed countries! In the United States, approximately 5 million individuals have HF, and more than 550,000 new cases are diagnosed annually! To our knowledge, only a few reports have focused on this issue in Japan.<sup>2,3</sup> The purpose of this study was to estimate the impact of population aging on the number of outpatients with left ventricular dysfunction (LVD) over the next 5 decades in Japan. All study participants provided informed consent and the study design was approved by the ethics review board of Niigata University Graduate School of Medical and Dental sciences.

We applied estimated age-, gender-, and condition-specific prevalences to the projected Japanese population in each age group and gender for the future until 2055, to provide a prospective estimate of the number of these patients. The primary data source was the Sado Heart Failure Study, a hospital-based research project primarily designed to count the number of patients with LVD by total enumeration in all hospitals on the island of Sado. The proportion of echocardiographically diagnosed systolic (SD) and isolated diastolic dysfunction (IDD) patients (together referred to as LVD) in the general population in 2003<sup>4,5</sup> was used as a substitute for the prevalence of LVD in the present study

(see Appendix 1).

The ratio of outpatients with SD or IDD to the general population of Sado City in 2003 was calculated as follows:<sup>4,5</sup>

$$\frac{\text{No. of outpatients (45–84 years old) on January 1st, 2003}}{\text{Estimated population of Sado City (45–84 years old) on January 1st, 2003}} \times 100$$

The 2005 census indicated the distribution of age groups in Japan.<sup>6</sup> The proportions of 3 major age groups (children (aged under 15), working-age (15–64) and aged (aged ≥65) in the total population were 14%, 66%, and 20%, respectively, in Japan, and 12%, 53%, and 35%, respectively, in Sado City. The ratio of men to women aged 45 and over was 1:1.15 in Japan and 1:1.20 in Sado City.

The second data source was the population projections of the Report of the Japanese National Institute of Population and Social Security Research (2006) for the next 5 decades.<sup>7</sup> The projected numbers of Japanese patients were calculated by multiplying each ratio by the projected count of its corresponding population category.

The total count of Japanese outpatients with LVD was 979,000 in 2005 and is expected to increase rapidly by 90,000 every 5 years until 2020, then gradually by 24,000 every 5 years until 2035, peaking at 1.32 million LVD patients in 2035. Males will dominate the LVD population as a whole, and in particular those aged <85 years. On the other hand, LVD patients aged ≥85 years will show female predominance, and the total count of this category will increase rapidly from 91,000 in 2005 to 333,000 in 2040. The epidemic will persist in the decremental phase of the Japanese population after 2005. The total count of Japanese LVD patients aged 65–84 years will gradually increase to a peak by 2025, followed by a later reduction, whereas the count of LVD patients aged <65 years has already been decreasing since 2005.

Thus, the estimated total count of outpatients with LVD in Japan was 979,000 in 2005, according to the calculations

(Received November 1, 2007; revised manuscript received December 6, 2007; accepted December 26, 2007)

Division of Cardiology, First Department of Internal Medicine, Niigata University Graduate School of Medical and Dental Sciences, Niigata, \*Sado General Hospital, Sado and \*\*Department of Public Health, Niigata University Graduate School of Medical and Dental Sciences, Niigata, Japan

Mailing address: Yuji Okura, MD, Division of Cardiology, First Department of Internal Medicine, Niigata University Graduate School of Medical and Dental Sciences, 1-754 Asahimachi, Niigata 951-8510, Japan. E-mail: okuray@med.niigata-u.ac.jp

All rights are reserved to the Japanese Circulation Society. For permissions, please e-mail: cj@j-circ.or.jp

**Table 1** Counts (in 1,000 s) of SD, IDD, LVD, and the General Population Shown in Total and After Stratification by Gender, Age Intervals, and 5-Year Intervals (From 2005 Until 2055)

Year	Age (years)	Population			LVD			SD			IDD		
		Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
2005	45–64	35,454	17,563	17,891	312	207	104	169	125	43	143	82	61
	65–84	22,825	10,109	12,717	576	375	202	357	243	114	220	132	88
	≥85	2,936	814	2,121	91	37	54	63	27	36	28	10	18
	Total	61,215	28,486	32,729	979	618	361	588	395	194	391	224	167
2010	45–64	34,322	16,991	17,331	307	206	102	167	125	42	141	81	59
	65–84	25,507	11,464	14,042	652	427	225	406	278	128	246	149	97
	≥85	3,905	1,104	2,801	122	50	72	84	37	47	37	13	24
	Total	63,734	29,560	34,174	1,081	683	399	658	440	218	424	243	181
2015	45–64	32,476	16,072	16,403	279	185	94	150	112	37	129	73	56
	65–84	28,598	12,974	15,625	733	483	249	457	315	142	276	168	108
	≥85	5,183	1,596	3,587	164	72	92	114	53	61	50	19	31
	Total	66,257	30,642	35,615	1,176	741	435	721	481	240	455	259	195
2020	45–64	33,238	16,465	16,773	276	182	94	147	111	37	129	72	58
	65–84	29,476	13,399	16,078	767	505	263	479	329	151	288	176	112
	≥85	6,423	2,063	4,360	205	93	112	143	69	74	62	24	38
	Total	69,137	31,926	37,211	1,248	780	469	769	508	261	479	271	208
2025	45–64	33,639	16,663	16,975	284	189	96	152	114	38	132	75	57
	65–84	28,952	13,132	15,821	763	496	267	480	326	155	282	170	113
	≥85	7,402	2,431	4,971	237	110	127	165	81	84	72	28	43
	Total	69,993	32,226	37,767	1,284	794	490	798	521	277	486	273	213
2030	45–64	32,894	16,316	16,578	290	193	97	157	117	40	133	76	56
	65–84	28,182	12,800	15,382	752	487	265	478	323	155	274	164	110
	≥85	8,488	2,836	5,652	273	128	145	190	95	96	82	33	49
	Total	69,564	31,952	37,612	1,315	808	507	825	534	291	489	274	216
2035	45–64	30,929	15,382	15,546	279	188	91	152	113	38	127	74	53
	65–84	27,115	12,401	14,714	714	469	246	451	309	142	264	160	104
	≥85	10,134	3,474	6,660	327	157	171	229	116	113	99	41	58
	Total	68,178	31,258	36,920	1,321	813	508	831	538	293	489	275	214
2040	45–64	27,619	13,777	13,842	246	166	81	134	100	34	113	66	47
	65–84	28,194	12,989	15,205	734	487	247	460	319	141	274	168	106
	≥85	10,333	3,520	6,813	333	159	175	233	118	115	100	41	59
	Total	66,146	30,286	35,860	1,313	811	502	827	537	290	487	275	212
2045	45–64	25,666	12,836	12,830	227	153	74	123	92	31	104	60	44
	65–84	28,599	13,182	15,417	754	498	256	474	326	147	280	172	108
	≥85	9,808	3,325	6,484	316	150	166	221	111	110	95	39	56
	Total	64,073	29,343	34,730	1,297	801	496	817	530	287	480	271	209
2050	45–64	24,190	12,096	12,095	212	142	70	115	86	28	97	56	41
	65–84	27,918	12,877	15,041	744	488	256	470	322	149	274	166	107
	≥85	9,722	3,350	6,372	314	151	163	220	112	108	95	39	55
	Total	61,831	28,323	33,509	1,270	781	489	805	520	285	465	262	204
2055	45–64	22,731	11,352	11,379	200	134	66	108	81	27	92	53	39
	65–84	26,196	12,111	14,084	710	463	246	452	308	145	257	156	102
	≥85	10,268	3,612	6,656	333	163	171	233	121	113	100	42	58
	Total	59,194	27,075	32,119	1,243	760	483	794	509	285	449	251	198

SD, systolic dysfunction; IDD, isolated diastolic dysfunction; LVD, left ventricular dysfunction.

of this study. In another study, the number of Japanese patients with chronic HF was estimated by indirect methods, such as the frequency of digitalis prescription,<sup>3</sup> and was found to be 1.07 million, consistent with our estimate. However, these estimates are much lower than the US ones! Considering that the population of the US is 2.5-fold that of Japan, the total count of LVD patients in Japan is expected to be less than half that of the US. Nevertheless, exact comparisons of the LVD patient counts between Japan and the US seem difficult because of the use of different methodologies and population structures. However, the incidence of myocardial infarction in Japan is reported to be one-sixth that of the US.<sup>8</sup> Therefore, the lower number of LVD patients in Japan could be partly explained by the lower prevalence of ischemic heart disease.

The incidence of LVD will first rapidly and then gradually increase to a peak of 1.32 million patients by 2035, with rapid acceleration occurring by 2020. As the proportion of LVD cases in the general population increases progressively with age, the problem of LVD is expected to inflate in progressively aging communities such as Japan (currently, 1 in 5 Japanese is aged over 65 years, and this proportion will reach 1 in 4 by 2020, and 1 in 3 by 2050<sup>7</sup>). The impact of LVD in Japan is greater than in European countries, because a larger proportion of Japan's current population is older; to reach a similar increase in the general aging population would require 115 years for France and 88 years for Sweden.<sup>9</sup> In particular, the epidemic-like prevalence of LVD patients aged ≥85 years in Japan will be unprecedented in the world. This category will increase rapidly

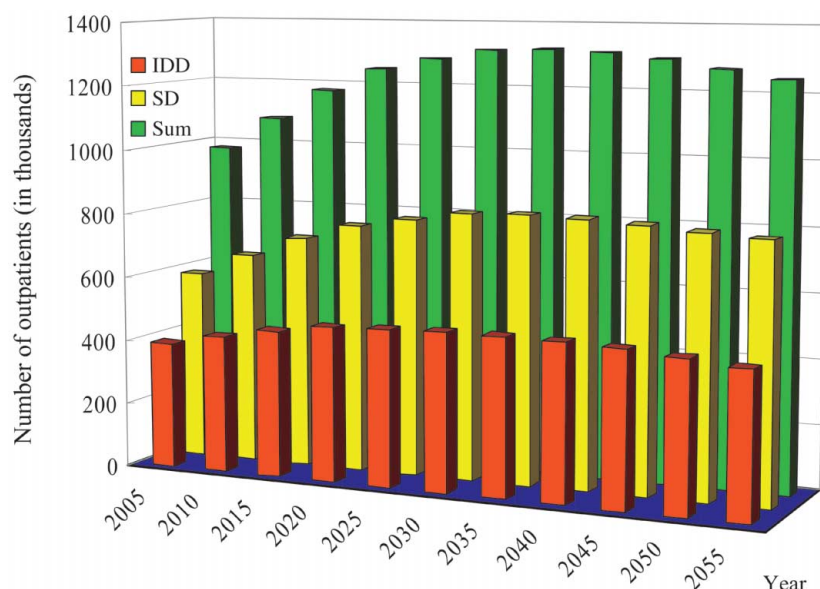


Fig 1. Bar graphs showing the cumulative total counts of systolic dysfunction (SD), isolated diastolic dysfunction (IDD), and left ventricular dysfunction stratified by 5-year intervals (from 2005 until 2055).

from 91,000 in 2005, to 333,000 in 2040 and the epidemic will be sustained until 2045. This is in contrast to a gradual reduction in the number of LVD patients aged <65 from 2005, and those aged 65–84 years after 2025. In this setting, it is important to confirm that the unique age structure of the general population in Japan requires the application of evidence-based algorithms derived from longitudinal and observational cohort studies conducted in Japanese populations.

Limitations of this study include, first, that the Japanese LVD prevalence data were derived from hospital-based studies. In fact, these estimates reflect the number of outpatients who are confirmed by echocardiography to have LVD in community hospitals, not in the general population. Thus, there is a possibility of underestimating the actual prevalence of LVD in the general population because of selection bias arising from the fact that patients with latent LVD in the community are not identified simply because of their non-referral to echocardiographic examination. Second, Sado City is an isolated island with an advanced aging population, and may not be a representative Japanese community model. However, no one representative city has been proposed as a standard to study the prevalence of LVD in Japan until now; thus, Sado City is the nearest to realizing this goal owing to its natural isolation, suitable population size, and identifiable, easily accessible organized centers for medical care. Third, this future projection was undertaken on the assumption that the prevalence of LVD in 2003 would remain constant in the future in Japan. Actually, the incidence of LVD can change. Therefore, recalibrating the prevalence over the short term seems prudent for a more precise projection of long-term LVD prevalence.

In conclusion, as the proportion of LVD patients in Japan increases progressively with age, it is expected to simulate a future epidemic.

#### Acknowledgment

This study was funded by a Grant-in-Aid for Basic Research on Science and Technology (C): "Comprehensive comparative evaluation of risk factors for hospitalization and death of patients with chronic heart failure in urban and rural regions" (17606003).

#### References

1. American Heart Association. Heart disease and stroke statistics: 2005 update. Dallas: AHA, 2005.
2. Okamoto H, Tsutsui H. Epidemiology of heart failure in Japan. *Nippon Rinsho* 2007; **65**(Suppl 4): 49–54 (in Japanese).
3. Okamoto H, Kitabatake A. The epidemiology of heart failure in Japan. *Nippon Rinsho* 2003; **61**: 709–714 (in Japanese).
4. Okura Y, Ohno Y, Suzuki K, Taneda K, Ramadan MM, Mitsuma W, et al. Characterization of outpatients with systolic dysfunction in a Japanese community by total enumeration. *Circ J* 2007; **71**: 1004–1012.
5. Okura Y, Ohno Y, Ramadan MM, Suzuki K, Taneda K, Obata H, et al. Characterization of outpatients with isolated diastolic dysfunction and evaluation of the burden in a Japanese community: Sado Heart Failure Study. *Circ J* 2007; **71**: 1013–1021.
6. Statistics Bureau, Ministry of Internal Affairs and Communications. Japan population census 2005. Tokyo: the Ministry. Available at: <http://www.stat.go.jp/data/kokusei/2005/index.htm> (in Japanese).
7. National Institute of Population and Social Security Research. Population projections for Japan: 2006–2055 (Editorial). Tokyo: Health and Welfare Statistics Association; 2007.
8. Japanese Circulation Society. Guidelines for the primary prevention of ischemic heart disease (JCS 2002). *Jpn Circ J* 2001; **65**(Suppl V): 1000–1001.
9. Department of Economic and Social Affairs, Population Division of United Nations. Percentage distribution of the population in selected age groups, by country, 2005 and 2050. In: *World Population Prospects: The 2004 Revision (Highlights)*. New York: United Nations; 2005; 53–57.

#### Appendix 1

The prevalences used in the present study for males with SD were 9/2,308, 13/2,934, 19/2,332, 26/2,219, 58/2,713, 66/2,727, 47/2,066, and 40/1,198 for the age groups 45–49, 50–54, 55–59, 60–64, 65–69, 70–74, 75–79, and 80–84 years, respectively; those for females were 1/1,989, 3/2,471, 9/2,302, 9/2,496, 14/3,294, 29/3,409, 30/3,041, and 37/2,185 for the age groups 45–49, 50–54, 55–59, 60–64, 65–69, 70–74, 75–79, and 80–84 years, respectively. The prevalences for males with IDD were 4/2,308, 10/2,934, 13/2,332, 17/2,219, 32/2,713, 43/2,727, 25/2,066, and 14/1,198 for the age groups 45–49, 50–54, 55–59, 60–64, 65–69, 70–74, 75–79, and 80–84 years, respectively; those for females were 9/1,989, 5/2,471, 9/2,302, 8/2,496, 19/3,294, 22/3,409, 23/3,041, and 19/2,185 for the age groups 45–49, 50–54, 55–59, 60–64, 65–69, 70–74, 75–79, and 80–84 years, respectively. The prevalence of outpatients aged 80–84 years was also applied to those aged ≥85 years, owing to the lack of data for the latter group.