



# Surgically treated gastric cancer in Japan: 2011 annual report of the national clinical database gastric cancer registry

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## Abstract

**Background** The National Clinical Database (NCD) nationwide registry program of gastric cancer started in 2018. The purpose of this study was to report the treatment results of the NCD registry in the form of treatment results of the real world in Japan.

**Methods** Patients' characteristics, tumor features, treatments, and outcomes were collected using a web-based data entry system. We analyzed the initial NCD database for data on surgically treated gastric cancer patients in 2011.

**Results** A total of 30,257 patients with malignant gastric tumors were enrolled by the NCD registry program from 501 hospitals in all 47 prefectures. Of these, the status of data entry was not approved in 8.8% of the registered data, and follow-up information was missing in 1.2% of the approved cases. Excluding 1777 cases, which were not resected for primary gastric cancer, 25,306 resected cases included 44.4% of stomach surgeries recorded in the NCD. The 5 year survival rate of the resected cases was 71.3% and the operative mortality rate was 0.41%. The stage-specific 5 year survival rates were as follows: 89.6% for stage IA, 83.8% for stage IB, 77.3% for stage IIA, 69.1% for stage IIB, 58.7% for stage IIIA, 44.1% for stage IIIB, 30.1% for stage IIIC, and 13.4% for stage IV.

**Conclusions** The NCD gastric cancer registry program demonstrated validity for database construction. The gastric cancer registry is expected to become a nationwide registry with the dissemination of data entry system and method in the NCD.

**Keywords** Gastric cancer registry · National Clinical Database · Annual report

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## Introduction

In 1963, the Japanese Research Society for Gastric Cancer launched a nationwide gastric cancer registry to collect details on the development and prevalence of the research on gastric cancer. This was the precursor of the Japanese Gastric Cancer Association (JGCA), and has been continued, with a decade of inactivity, to date by the JGCA [1–5]. A number of JGCA members voluntarily participate in this registry program. Surgical cases were registered in the JGCA first, and endoscopic cases were additionally registered from 2006. In 2018, 27,034 surgically treated patients were registered from 366 hospitals, and 8681 endoscopically treated patients were registered from 162 hospitals in the 2011 registry [1].

The National Clinical Database (NCD) of Japan was founded in April 2010 as a result of the participation of 10 surgical subspecialty academies associated with the board certification system [6, 7]. The NCD commenced data registration in 2011, and has since become a nationwide database covering more than 95% of the surgeries performed [8]. To date, more than 5200 facilities have enrolled in the NCD, with a registration of approximately 1,500,000 cases per year [9]. The NCD was built as a platform for surgical procedures to evaluating the practices and outcomes, and ultimately, provide better medical care. Additionally, some organ-specific cancer registries, such as those for pancreatic and breast cancer, were implemented to the NCD from the beginning, while hepatocellular cancer, urinary organ cancer, gastric cancer, and esophageal cancer were added later [10]. The Ministry of Health, Labour and Welfare has planned to construct databases of organ-specific cancer registries for patterns of care study and selected NCD as an organization of gastric cancer registry in 2017 [5]. In such a situation, the registration committee of the JGCA

and NCD planned to apply the same registration items of the conventional JGCA gastric cancer registry to the NCD gastric cancer registry, which started in 2018. Concomitantly, the registration method was changed from a by-mail to a web-based entry system.

Because data registration in the NCD program that can collect more nationwide data than the conventional program has started, we herein report that gastric cancer registry has led to a better understanding of the real-world situation with respect to gastric cancer in Japan.

## Methods

### Data source

The registered gastric malignant tumors were primary gastric cancer, remnant gastric cancer, gastrointestinal stromal tumor, malignant lymphoma, and other malignant tumor, and were all treated in 2011. The registration data are listed in Table 1, and consist of the same 73 items as the JGCA registry program, including personal information, surgical results, histological diagnosis, final diagnosis, treatment, and follow-up information according to the Japanese Gastric Cancer Association classification (14th edition), UICC TNM classification (7th edition), and the Japanese gastric cancer treatment guidelines (2010) [11–13]. The data were registered in the NCD using a web-based data entry system, by uploading an exported data set registered in the JGCA program, by direct data entry as a result of a relationship with previously registered surgeries, or by direct data entry in an organ-specific cancer registry site. The NCD gastric cancer registration program was approved by the Institutional Review Board of the Graduate School of Medicine, Kobe University (No.180265).

**Table 1** Registration data

Category	Item
Personal information	Name of hospital, date of birth, age at operation
Surgical results	Date of operation, approach, procedure, lymph node dissection, combined organ resection, type of reconstruction
Histological diagnosis	Tumor location, size, histological type, depth of tumor invasion, capillary invasion (ly, v), number of resected lymph node, number of metastatic lymph node, resection margin (PM, DM), CY
Final diagnosis	Macroscopic type, depth of invasion, fN, H, P, M, residual tumor, stage
Treatment	Chemotherapy (preoperative, intraoperative, postoperative), immunotherapy, radiotherapy
Follow-up information	Date of follow-up, life and death, cause of death, site of recurrence

*PM* proximal margin, *DM* distal margin, *CY* peritoneal lavage cytology, *f* final findings,

*N* lymph node metastasis, *H* hepatic metastasis, *P* peritoneal metastasis, *M* distant metastasis

## Statistical analysis

The collected data of primary gastric cancer patients were analyzed for 5 year survival rate considering various subgroups of prognostic factors, including patient characteristics, tumor status, and surgical procedure. The following data were calculated: total patients; direct death within 30 postoperative days; patients lost to follow-up within 5 years; survival rates by year; standard error of 5 year survival; 5 year survivors; death from gastric cancer, other cancer, other disease, and unknown cause; and recurrence site, such as local, lymph node metastasis, peritoneal metastasis, liver metastasis, and unknown site. The overall survival rates were calculated using the Kaplan–Meier method and were compared using the log-rank test. *P* values of  $<0.05$  were considered statistically significant. All statistical analyses were performed using SPSS Statistics 25.0 (IBM, USA).

## Results

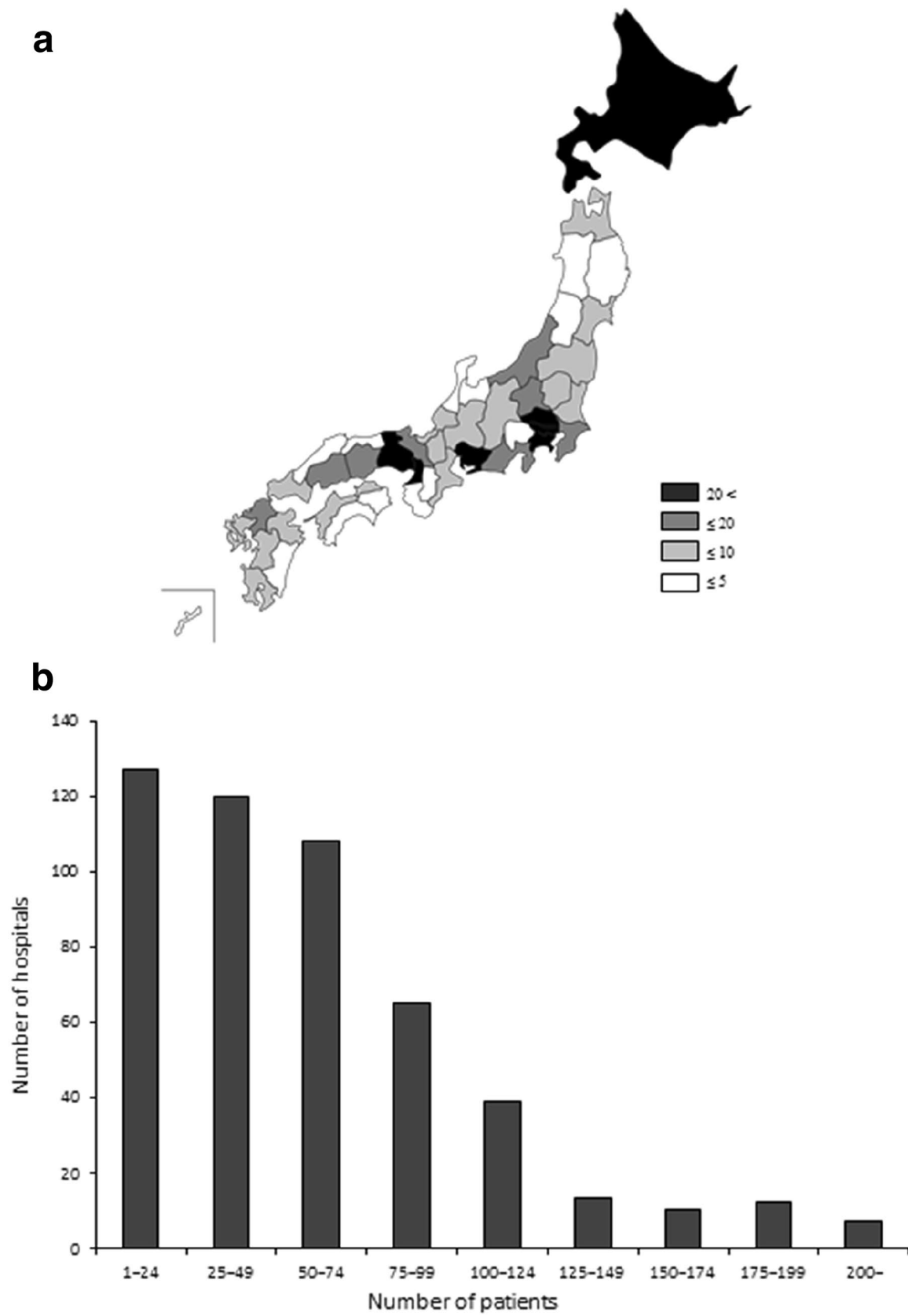
The data of 30,257 patients with malignant gastric tumors were enrolled from 501 hospitals in all 47 prefectures. The geographical distribution of the participating hospitals is illustrated in Fig. 1a. The median number of hospitals per prefecture was 7 (range 2–48). The composition of the enrolled data is shown in Fig. 1b. High-volume centers, recording more than 100 cases per year, accounted for 16.2% of all participating hospitals. Of 30,257 cases, 2656 cases (8.8%) without data entry approval and 325 cases (1.2%) without follow-up information were excluded. Additionally, 654 cases, including cases of remnant gastric cancer or other malignant tumor, cases with synchronous malignancy, non-surgical cases, and palliative surgery cases, were excluded. The remaining 26,622 patients were used for the analyses.

The 5 year survival rate (5YSR) of all patients with primary gastric cancer was 68.4% (Fig. 2a). With the exclusion of 1123 unresected cases, 189 atypically surgical procedure cases, and 4 unknown cases, the 5YSR was 71.3%, and the 30 day operative mortality rate was 0.41% in the 25,306 resected cases (Fig. 2b). Analyses of various subgroups for patient demographics and gastric cancer characteristics were performed for resected cases (Table 2). Patients aged  $\geq 80$  years old comprised 15.6% of the population, and their 5YSR was 49.6%, whereas that of patients aged 40–59 years old was 82.9% ( $P < 0.001$ ) (Fig. 2c). The proportion of male patients was 68.9%, and their 5YSR was lower than that of female patients (69.1% vs. 74.8%,  $P < 0.001$ ) (Fig. 2d). With regards to the primary tumor,

tumors in the upper-third of the stomach with esophageal invasion accounted for 23.4%, and the 5YSR (63.3%) of these cases was lower than the cases with tumors located at the middle-third (76.6%) and lower-third and duodenum (70.3%) ( $P < 0.001$ ) (Fig. 2e). The 5YSR of type 4 tumor was remarkably low at 25.2%, and the 28.3% of this tumor had peritoneal recurrence (Fig. 2f). With regards to histological classification, the proportion of undifferentiated tumor types, including poorly differentiated adenocarcinoma, signet-ring cell carcinoma, and mucinous adenocarcinoma was 45.9%, and their 5YSR was lower than that of differentiated type tumors, such as papillary adenocarcinoma and tubular adenocarcinoma (66.8% vs. 74.4%,  $P < 0.001$ ) (Fig. 2g). Early gastric cancer (pT1) accounted for 48.2%, the 5YSR was 88.7%, and death from gastric cancer was only 0.25% (Fig. 2h, i). Progression of venous invasion and lymphatic invasion were associated with poor prognosis (Fig. 2j, k). The proportion of cases that were negative for lymph node metastasis was 59.8%, and their 5YSR was 85.5% (Fig. 2l). In cases with non-curative factors, the presence of distant metastasis, peritoneal metastasis, positive peritoneal lavage cytology, and liver metastasis showed similar 5YSRs (Fig. 2m–p). The 5YSRs of patients stratified by pathological stage were 89.6% for stage IA, 83.8% for stage IB, 77.3% for stage IIA, 69.1% for stage IIB, 58.7% for stage IIIA, 44.1% for stage IIIB, 30.1% for stage IIIC, and 13.4% for stage IV (Fig. 2q, r). The results for surgical procedure and outcome are shown in Table 3. The groups classified based on surgical procedure had various tumor characteristics and survival differences among procedure groups were not precisely evaluated. Laparoscopic surgery was performed in 31.1%. Thoraco-laparotomy, which was performed for tumors with esophageal invasion, accounted for only 0.6%. Distal gastrectomy accounted for 59.6% and total gastrectomy was performed in 32.9%. D2 lymph node dissection was carried out for 43.6% of all resected patients, and had a low incidence of direct death at 0.25%. Combined resection was performed in 31.5% of all cases. R0 resection was achieved for 89.9%, and the 5YSR was 77.0% (Fig. 3). The predominant site of recurrence after R0 resection was the peritoneum, followed by the liver and distant lymph nodes.

## Discussion

The initial NCD gastric cancer registry collected 30,257 surgically treated cases from 501 hospitals in all 47 prefectures. The 55,278 stomach cancer surgeries, including total gastrectomy, distal gastrectomy, proximal gastrectomy,



**Fig. 1** **a** Geographic distribution of the registered hospitals in 47 prefectures. **b** Patient volume in the participating hospital

**Table 2** Gastric cancer characteristics

Category	Total number	Direct death	Lost f.u	Postoperative survival rate (%)			S.E. Site of recurrence			Cause of death										
				1 yr	2 yr	3 yr	4 yr	5 yr	L	LN	P	H	R	PD	OC	OD	UK			
Primary cancer	26,622	164	3316	88.0	80.6	75.2	71.4	68.4	0.3	232	530	1447	907	46	13,835	1585	498	1317	675	
Resected cases and unresected cases	25,306	104	3184																	
Resected cases	1123	50	105	91.2	83.6	78.2	74.3	71.3	0.3	199	501	1261	872	39	13,746	994		479	1265	630
Unresected cases	189	10	26	39.3	17.4	9.1	6.4	5.1	0.8	29	23	177	28	6	39	540		12	38	39
Other cases	189	10	26	63.9	48.4	42.9	39.3	35.0	3.9	4	6	9	7	1	48	51		7	14	6
Age (resected cases)																				
-39	444	0	52	96.3	89.8	85.2	82.8	80.9	2.0	3	6	37	9	0	289	12		4	3	1
40-59	4124	4	427	96.0	91.0	86.9	84.8	82.9	0.6	24	69	210	101	5	2729	102		26	49	31
60-79	16,140	66	1762	91.7	84.4	79.0	75.0	72.0	0.4	119	335	818	615	20	9108	618		331	735	342
80-	3830	30	792	81.7	68.9	61.3	54.9	49.6	0.9	49	85	188	141	13	1152	253		103	456	241
Sex (resected cases)																				
Male	16,923	78	2054	90.5	82.5	76.6	72.3	69.1	0.4	143	372	781	687	24	8921	677		393	979	445
Female	7622	22	980	92.1	85.0	80.8	77.4	74.8	0.5	53	123	473	179	14	4361	308		71	264	170
Tumor location (resected cases)																				
Upper third	5712	26	648	88.4	78.7	71.9	67.1	63.3	0.7	54	144	325	288	16	2786	318		117	379	163
esophageal invasion																				
Middle third	9749	25	1196	93.1	87.1	82.6	79.2	76.6	0.5	49	134	434	273	9	5739	271		179	420	199
Lower third	8824	46	1154	90.8	82.8	77.4	73.3	70.3	0.5	87	206	448	293	9	4690	365		164	424	245
duodenum																				
Whole	170	2	20	66.9	46.9	31.0	28.1	25.8	3.7	6	8	43	9	4	33	24		2	8	6
Macroscopic type (resected cases)																				
Type 0	12,497	22	1594	97.7	95.4	92.9	90.5	88.1	0.3	23	34	56	100	3	8614	57		263	542	199
Type 1	908	10	153	87.8	77.6	70.2	64.8	61.2	1.8	3	21	27	47	3	385	35		28	89	40
Type 2	3960	23	494	88.7	78.0	71.0	65.8	61.9	0.8	38	132	175	279	4	1829	196		68	253	132
Type 3	4646	31	508	83.7	69.1	60.1	54.3	50.5	0.8	71	214	476	330	16	1758	382		75	234	159
Type 4	1564	9	153	69.4	48.4	36.7	28.9	25.2	1.2	44	54	442	61	9	287	250		18	62	47
Type 5	778	3	92	83.6	71.3	61.4	56.0	52.4	1.9	16	32	74	47	3	310	53		9	54	36
Histological finding (resected cases)																				
Differentiated type	12,847	54	1691	93.5	87.1	82.0	77.7	74.4	0.4	73	202	302	476	15	7268	331		300	755	349

Table 2 (continued)

Category	Total number	Direct death	Lost f.u.	Postoperative survival rate (%)			S.E. Site of recurrence			Cause of death									
				1 yr	2 yr	3 yr	4 yr	5 yr	L	LN	P	H	R	PD	OC	OD	UK		
Undifferentiated type	11,268	43	1287	88.3	79.1	73.3	70.0	66.8	0.5	119	287	357	23	5808	631	155	469	256	
Other type	430	3	56	87.4	77.4	73.5	70.7	68.8	2.5	4	6	33	0	206	23	9	19	10	
Histological type (resected cases)																			
pap	656	6	110	89.4	79.1	72.0	67.1	63.9	2.1	4	17	45	1	294	24	18	54	23	
tub1	5178	15	735	96.1	91.8	87.6	83.9	81.0	0.6	14	46	89	4	3144	77	127	302	116	
tub2	7013	33	846	91.9	84.5	78.8	74.2	70.6	0.6	55	139	342	10	3830	230	155	399	210	
por1	3191	15	398	87.3	78.2	73.1	69.4	66.7	0.9	30	112	145	2	1613	175	46	175	78	
por2	5057	22	528	86.1	74.6	67.3	63.1	59.7	0.7	63	131	169	13	2334	355	68	201	127	
sig	2501	5	300	94.3	90.5	87.8	85.4	83.3	0.8	19	16	25	4	1635	62	35	66	38	
muc	519	1	61	87.4	73.3	63.0	58.2	56.0	2.3	7	28	18	4	226	39	6	27	13	
Endocrine	94	0	13	80.9	62.0	56.4	50.5	48.9	6.0	2	3	16	0	30	7	2	4	3	
cell carcinoma																			
noma																			
Carcinoma with lymphoid stroma	89	2	11	91.9	85.9	84.7	82.2	82.2	4.2	0	0	0	0	60	2	1	9	3	
Hepatoid adenocarcinoma	27	0	6	76.2	64.9	58.1	58.1	58.1	11.6	0	0	5	0	8	1	1	0	0	
Adenosquamous carcinoma	19	0	0	58.8	47.1	35.3	35.3	29.4	11.1	0	1	3	0	5	4	0	3	0	
Squamous cell carcinoma	14	0	2	100	91.7	91.7	91.7	82.5	11.3	0	1	0	0	9	1	0	0	0	
Undifferentiated carcinoma	20	0	1	89.5	78.6	67.4	61.8	61.8	11.4	0	1	3	0	11	1	0	0	0	
Miscellaneous carcinoma	167	1	23	92.3	85.2	82.7	81.0	78.2	3.7	2	0	6	0	83	7	5	3	4	
Tumor invasion (resected cases)																			
pT0	101	0	12	100	95.7	91.3	85.6	84.4	3.8	0	3	2	0	71	2	0	1	1	
pT1a(M)	5341	8	735	98.2	96.6	94.9	93.2	91.2	0.4	4	4	4	0	3766	10	95	201	78	
pT1b(SM)	6463	10	817	97.6	95.0	92	89.3	86.7	0.5	4	25	77	4	4392	19	148	332	121	

Table 2 (continued)

Category	Total number	Direct death	Lost f.u	Postoperative survival rate (%)					Site of recurrence					Cause of death						
				1 yr		2 yr		3 yr	L		LN		5 yr	P	H	R	PD	OC	OD	UK
				4 yr	5 yr	4 yr	5 yr	4 yr	5 yr	4 yr	5 yr	4 yr	5 yr	4 yr	5 yr	4 yr	5 yr	4 yr	5 yr	4 yr
pT2(MP)	2746	14 360		95.590.385.2	81.678.2	0.9	15	49				19	91	2	1639	34	54	168	76	
pT3(SS)	4347	18 509		89.679.671.7	65.962.0	0.8	53	154				234	312	8	2066	193	98	248	119	
pT4a(SE)	4775	36 515		76.056.745.9	39.235.1	0.8	92	229				848	330	22	1210	588	58	240	184	
pT4b(SI)	694	12 70		63.239.830.3	24.821.5	1.7	26	29				129	50	2	106	134	7	48	35	
Subclassification of submucosa (resected cases)																				
SM1	1662	3 224		97.696.093.1	90.187.0	0.9	1	2				4	11	1	1133	5	41	87	35	
SM2	4815	8 595		97.694.691.7	89.086.5	0.5	3	21				12	68	3	3269	16	106	246	87	
Lymphatic invasion (ly) (resected cases)																				
ly0	11,053	21 1459		97.194.3	91.188.5	86.1	0.4	27			48	155	98	3	7439	93	207	485	216	
ly1	6225	29 752		92.785.2	79.474.7	71.1	0.6	56			99	282	227	11	3377	207	137	355	154	
ly2	3787	12 422		84.471.3	62.556.9	53.1	0.9	58			146	359	267	7	1508	256	68	225	126	
ly3	3217	35 353		73.554.1	45.039.3	35.9	0.9	52			197	448	269	17	823	417	47	164	116	
Venous invasion (v) (resected cases)																				
v0	13,340	30 1749		96.392.789.2	86.283.6	0.3	49	106			296	159	5	8641	142	251	608	275		
v1	5959	22 677		88.177.671.0	66.262.5	0.7	69	178			458	266	20	2841	323	125	325	154		
v2	3371	24 397		82.267.758.2	52.549.0	0.9	51	139			329	242	11	1221	295	58	198	129		
v3	1609	21 159		74.455.546.9	41.438.0	1.3	24	65			161	196	2	451	211	26	99	53		
Lymph node metastasis (resected cases)																				
pN0	14,560	31 1948		97.094.191.1	88.185.5	0.3	39	51			191	111	6	9614	106	308	726	276		
pN1	3265	10 408		92.184.278.1	73.570.2	0.9	36	49			147	147	4	1737	126	58	170	89		
pN2	2724	17 297		84.870.962.3	56.853.0	1.0	46	106			221	228	10	1091	183	46	159	94		
pN3a	2306	15 209		77.557.445.1	38.434.2	1.1	49	160			345	230	9	600	281	28	104	90		
pN3b	1509	17 140		64.539.527.9	21.117.8	1.1	22	125			339	145	9	193	258	18	67	59		
Distant metastasis (M) (resected cases)																				
fM0	22,292	69 2828		94.188.083.1	79.276.1	0.3	154	390			787	682	29	13,040	405	443	1143	531		
fM1	247	30 177		57.932.821.8	15.813.4	0.8	40	103			461	181	9	200	576	19	90	83		
Peritoneal metastasis (P) (resected cases)																				
fP0	23,262	80 2893		92.386.080.9	76.973.8	0.3	172	464			971	798	31	13,171	596	449	1186	573		
fP1	1153	18 118		54.128.217.2	12.0	9.3	1.0	21	28		274	63	6	69	377	12	46	38		
Peritoneal cytology (CY) (resected cases)																				
CY0	11,713	40 1309		91.382.175.5	70.867.3	0.5	118	339			687	579	20	6142	391	211	644	334		
CY1	1335	17 115		58.232.021.3	15.012.1	1.0	20	56			346	98	7	113	335	8	62	53		
Liver metastasis (H) (resected cases)																				
fH0	24,054	87 2980		91.784.278.8	74.871.8	0.3	188	489			1222	799	38	13,213	833	455	1215	598		

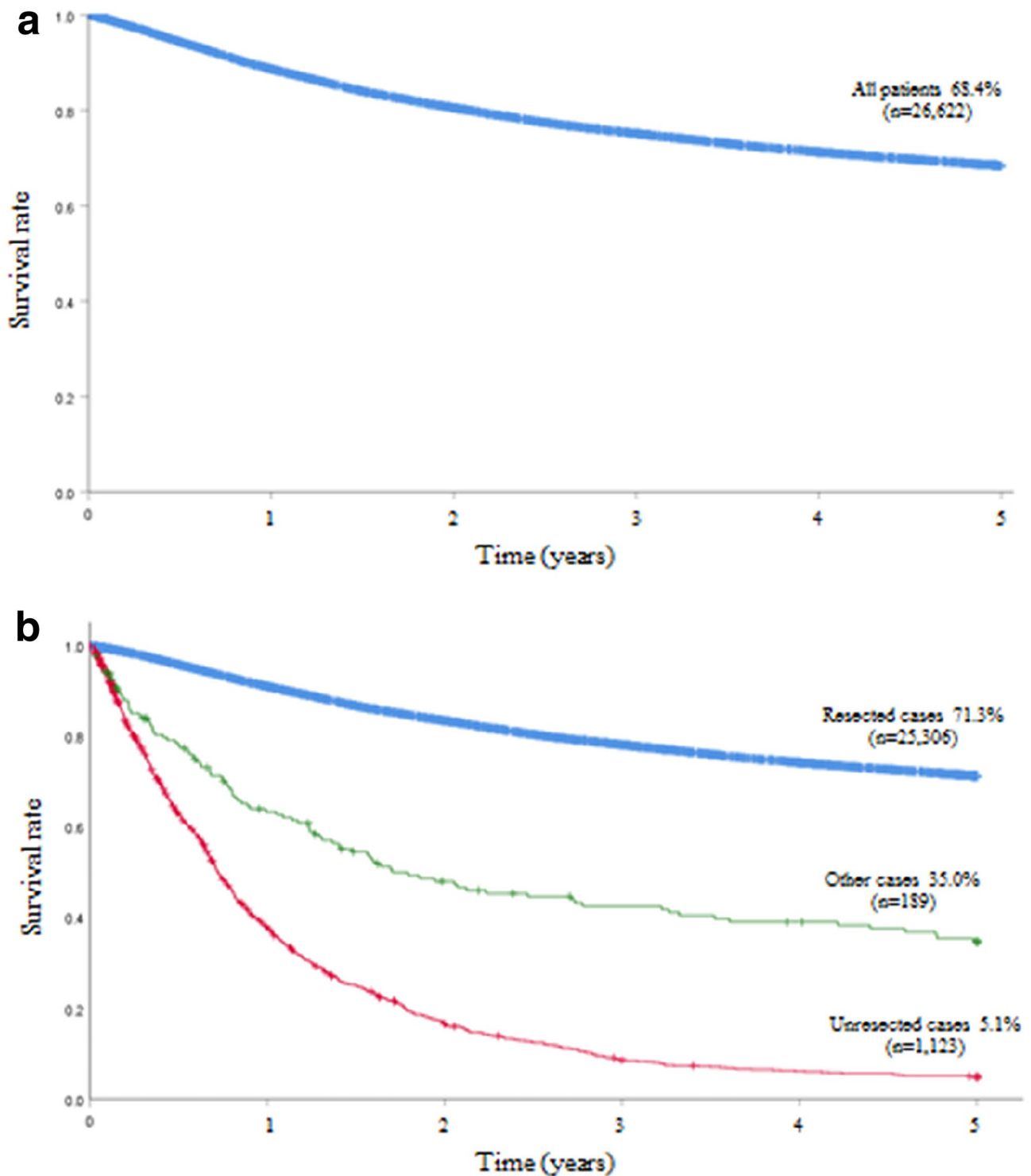
Table 2 (continued)

Category	Total number	Direct death number	Lost f.u.	Postoperative survival rate (%)			S.E. Site of recurrence			Cause of death									
				1 yr	2 yr	3 yr	4 yr	5 yr	2.0	5	4	H	R	P	PD	OC	OD	UK	
fH1	372	12	32	46.4	25.3	18.2	14.7	13.5	2.0	5	4	63	0	34	136	4	17	15	
Stage (resected cases)																			
Stage IA	10,457	16	1397	98.1	96.3	94.1	91.9	89.6	0.3	3	10	30	3	7288	16	222	463	173	
Stage IB	2501	5	334	97.2	93.8	90.0	86.8	83.8	0.8	10	16	44	1	1599	10	50	142	57	
Stage IIA	2294	7	278	95.3	90.4	86.3	81.6	77.3	0.9	16	23	74	1	1391	25	56	144	60	
Stage IIB	1994	10	258	92.9	84.6	77.2	72.3	69.1	1.1	25	50	87	3	1051	47	32	118	52	
Stage IIIA	1667	7	181	90.8	78.2	69.0	63.0	58.7	1.3	28	55	135	5	743	65	33	95	61	
Stage IIIB	1650	9	176	84.3	68.0	56.6	48.6	44.1	1.3	28	109	165	8	547	89	29	98	57	
Stage IIIC	1533	9	171	76.7	54.4	41.8	34.9	30.1	1.3	40	119	143	8	335	136	18	71	67	
Stage IV	2167	30	181	57.8	32.8	21.7	15.8	13.4	0.8	40	103	181	9	201	583	19	92	83	
Stage (4 classification) (resected cases)																			
Stage I	12,958	21	1731	97.9	95.8	93.3	90.9	88.5	0.3	13	26	74	4	8887	26	272	605	230	
Stage II	4288	17	536	94.2	87.7	82.1	77.3	73.5	0.7	41	73	161	4	2442	72	88	262	112	
Stage III	4850	25	528	84.1	67.3	56.3	49.3	44.8	0.8	96	283	443	21	1625	290	80	264	185	
Stage IV	2167	30	181	57.8	32.8	21.7	15.8	13.4	0.8	40	103	181	9	201	583	19	92	83	

Unknown cases were excluded. NX, MX, PX, CYX, HX, RX were excluded

Direct death direct death within 30 postoperative days, *Lost f.u.* lost to follow-up, *SE* standard error, *L* local, *LN* lymph node, *P* peritoneum, *H* liver, *R* recurrence at known site, *PD* primary disease, *OC* other cancer, *OD* other disease, *UK* unknown, *Pap* papillary adenocarcinoma, *tub1* tubular adenocarcinoma, well differentiated type, *tub2* tubular adenocarcinoma, moderately differentiated type, *por1* poorly differentiated adenocarcinoma, solid type, *por2* poorly differentiated adenocarcinoma, non-solid type, *sig* signet-ring cell carcinoma, *mic* mucinous adenocarcinoma, *p* pathological findings, *T0* no evidence of tumor, *M* mucosa or muscularis mucosa, *SM* submucosa, *MP* muscularis propria, *SS* subserosal, *SE* serosa, *SJ* adjacent structure, *f* final findings





**Fig. 2** Kaplan–Meier survival curves of patients stratified to various subsets of prognostic factors for patient demographics and tumor characteristics. **a** All patients with primary gastric cancer, **b** resected cases and unresected cases, **c** age category, **d** sex, **e** tumor location, **f** macroscopic type, **g** histological classification, **h** depth of tumor inva-

sion, **i** depth of subclassification of submucosa, **j** lymphatic invasion, **k** venous invasion, **l** lymph node metastasis, **m** distant metastasis, **n** peritoneal metastasis, **o** peritoneal cytology, **p** liver metastasis, **q** stage, and **r** stage (IV classification)

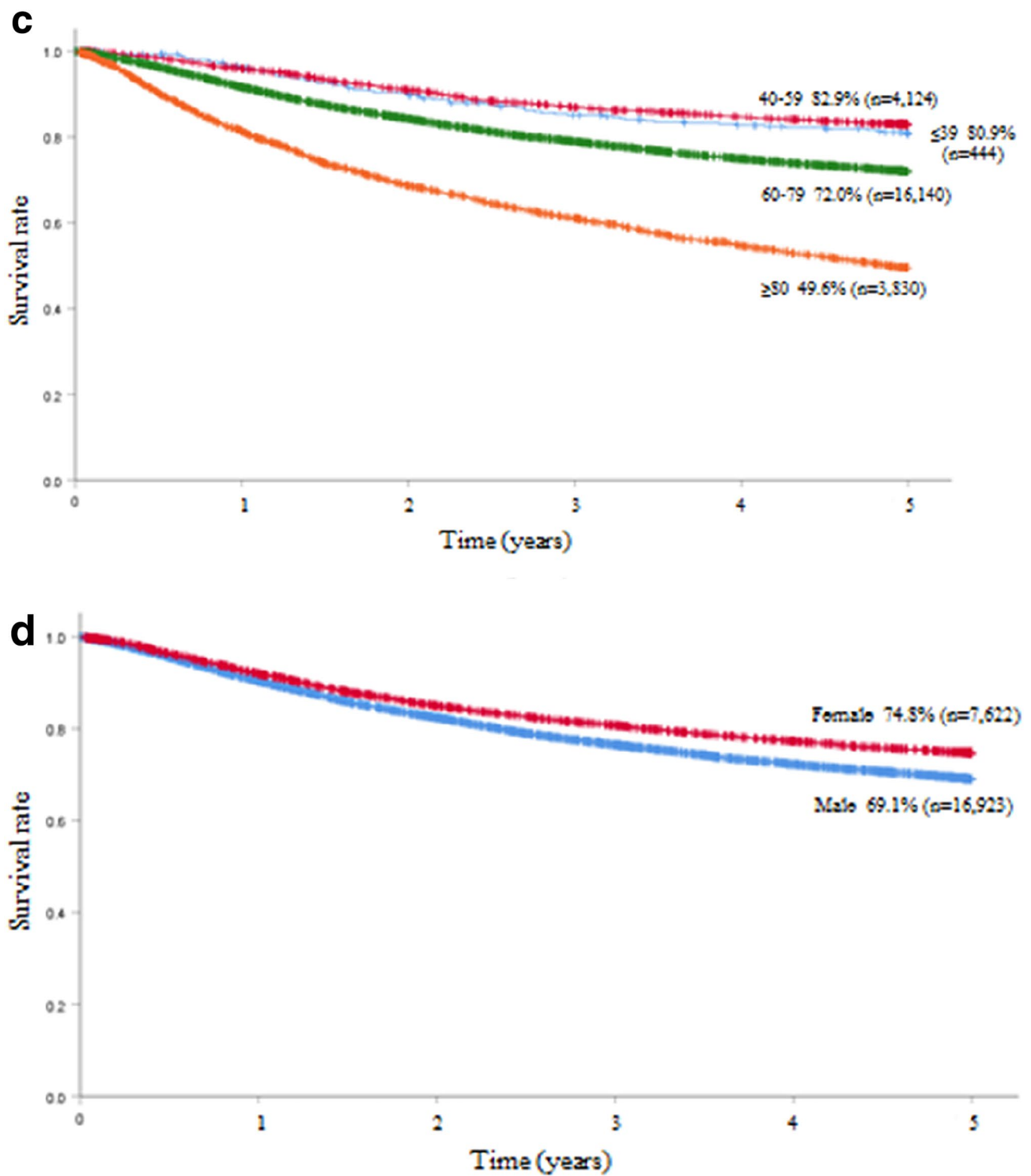


Fig. 2 (continued)

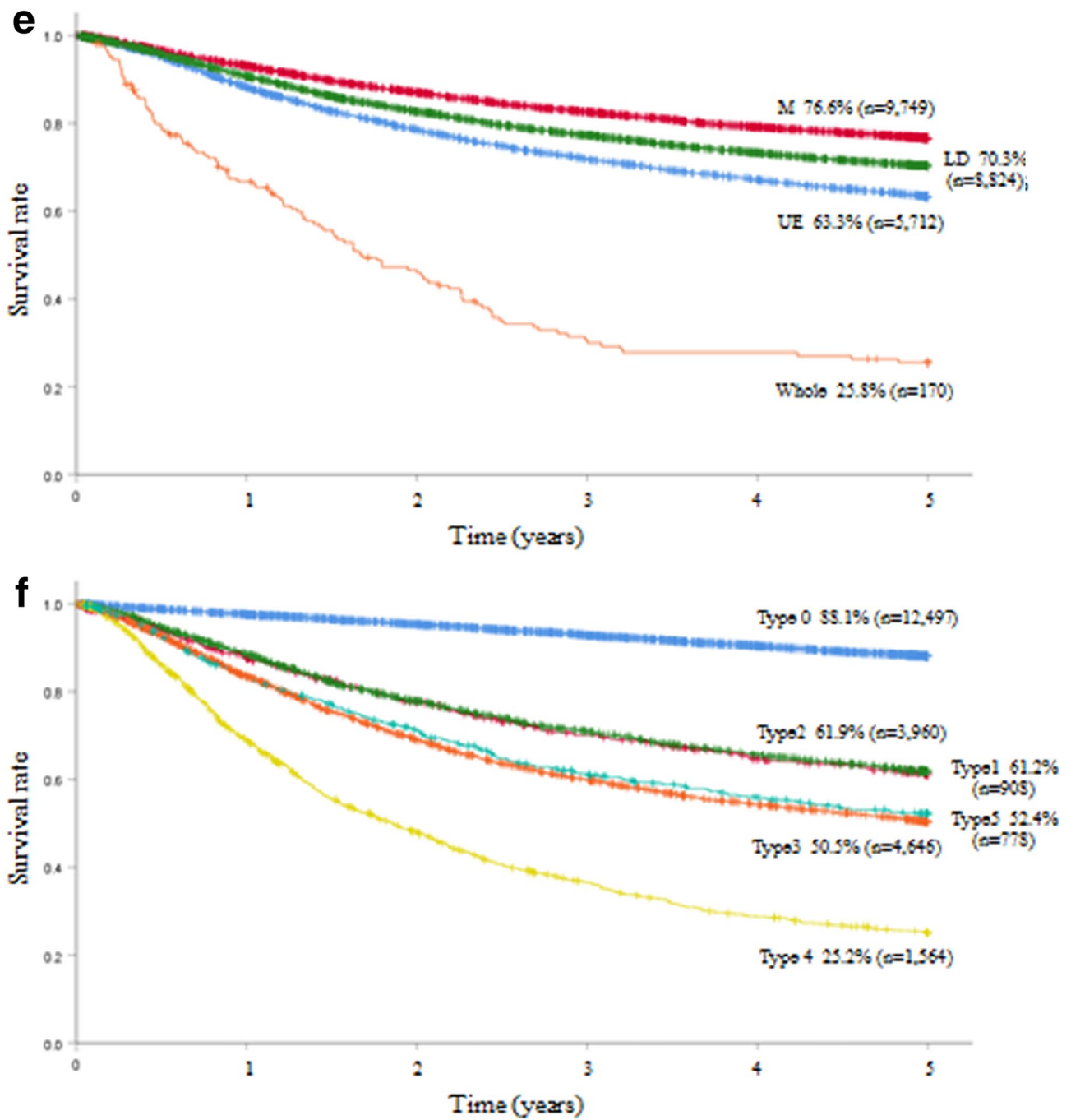


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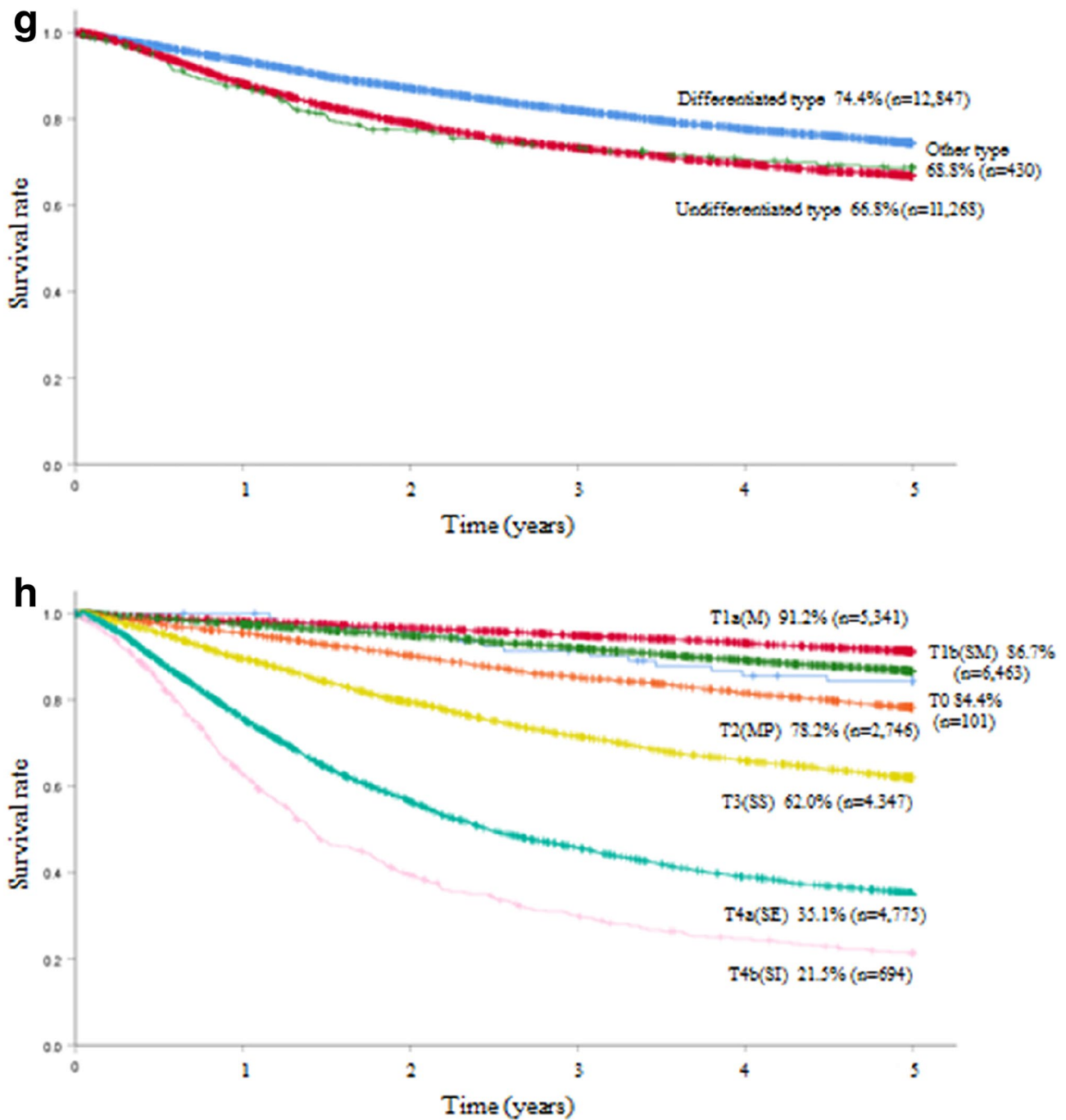


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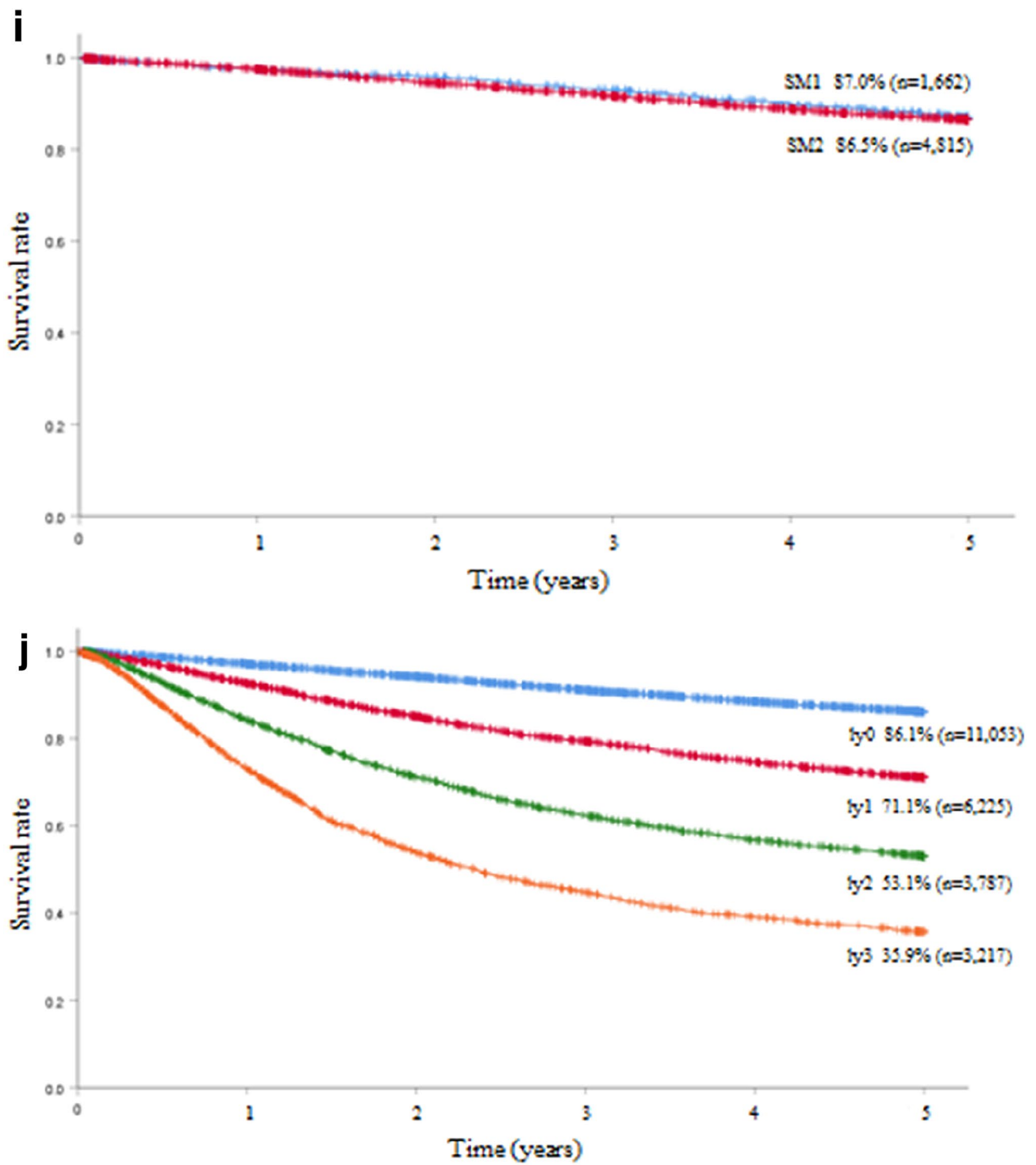


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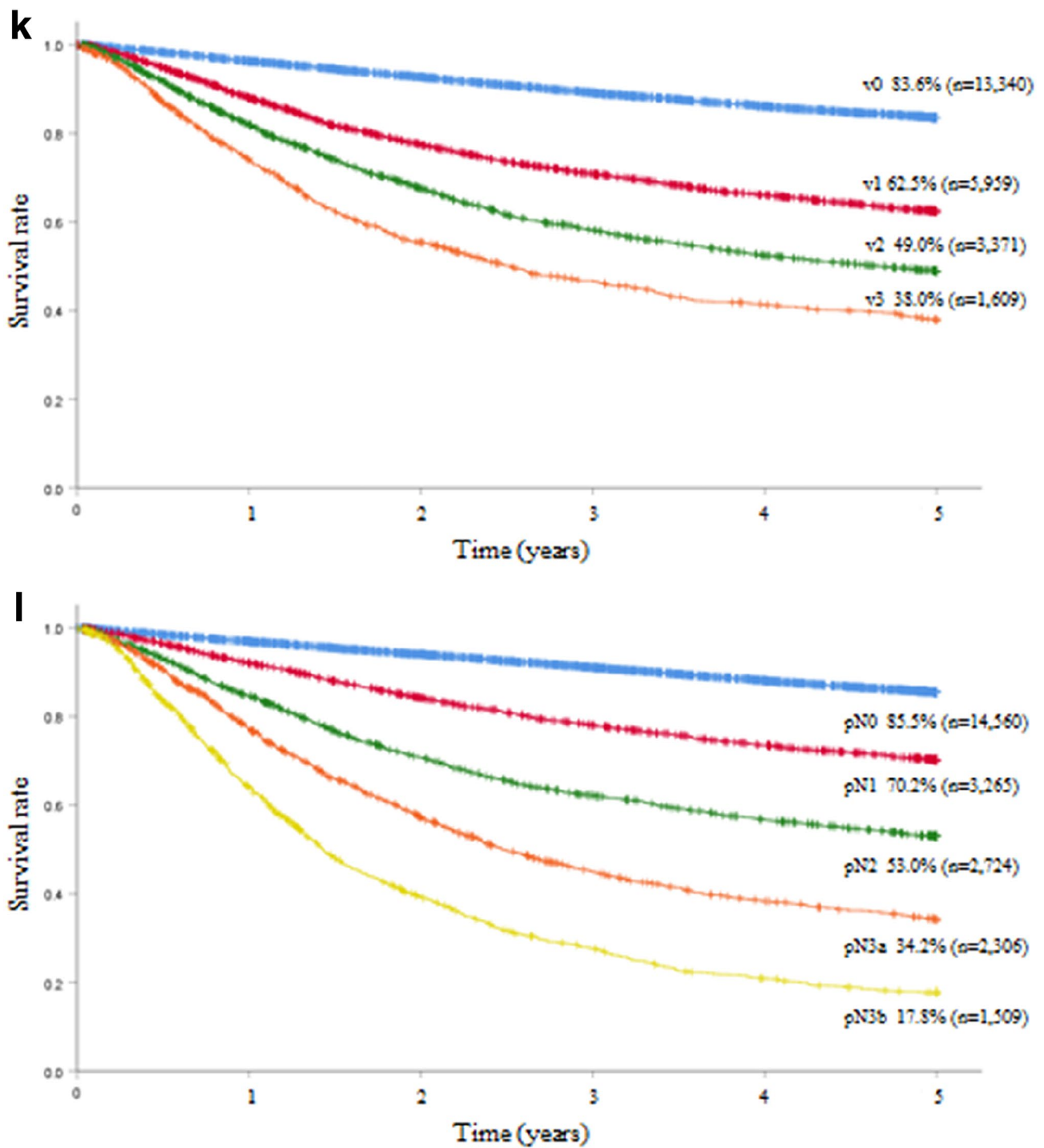


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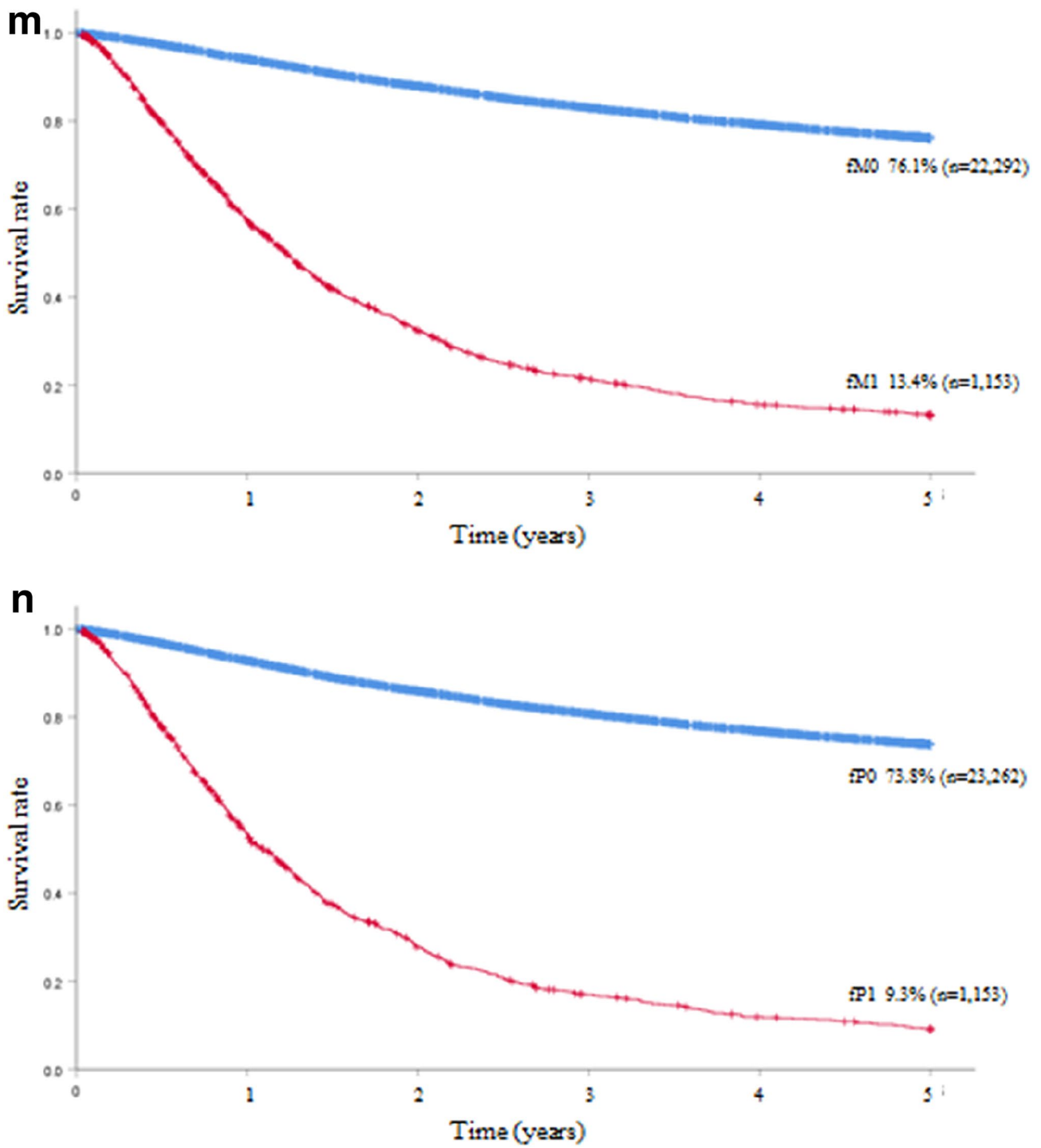


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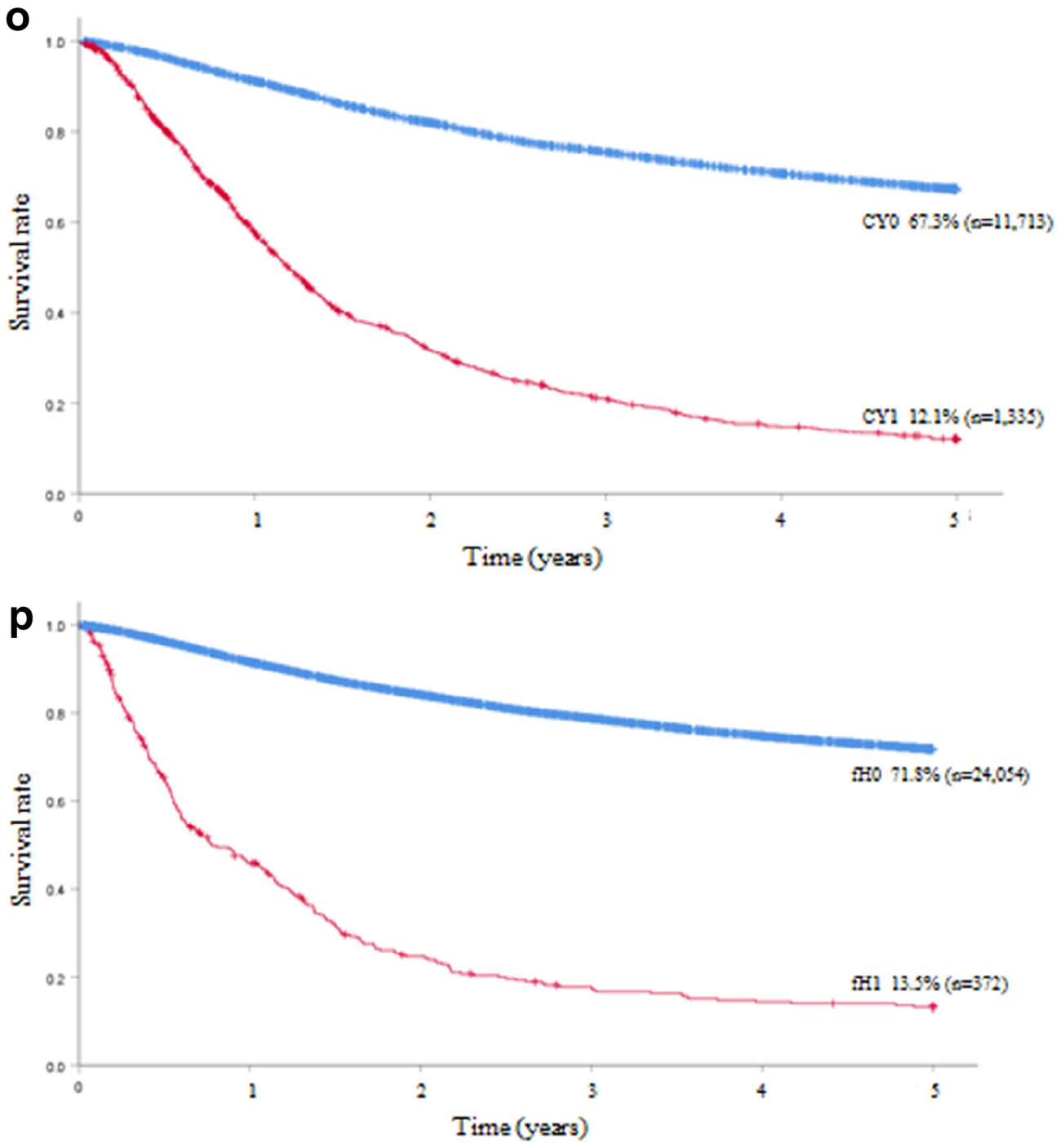


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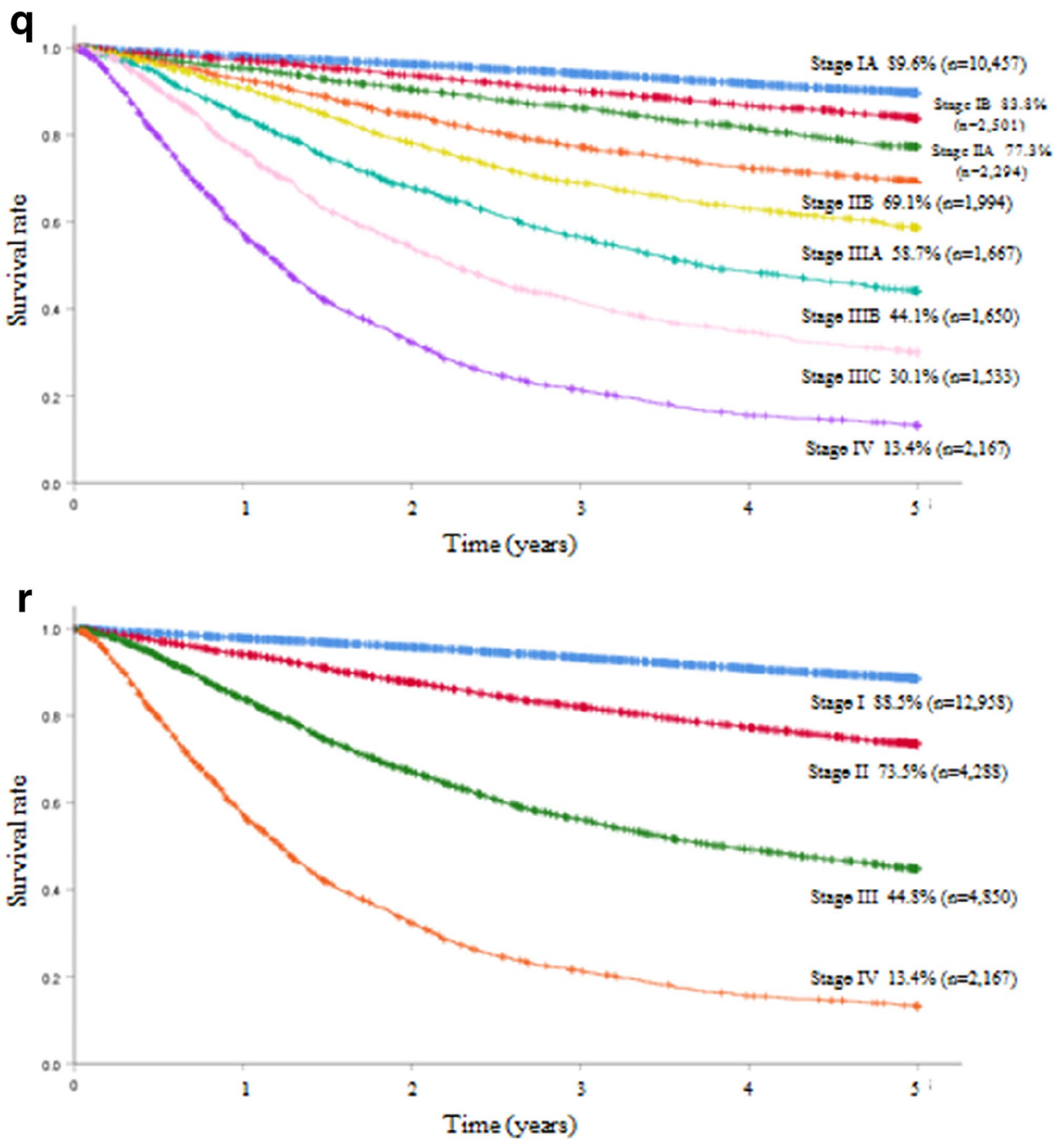


Fig. 2 (continued)

Table 3 Surgical outcomes

Categories	Total number	Direct death	Lost f.u.	Postoperative survival rate (%)					S.E. at 5 yr	Site of recurrence					Cause of death				
				1 yr	2 yr	3 yr	4 yr	5 yr		L	LN	P	H	R	PD	OC	OD	UK	
Approach (resected cases)																			
Lapa-rotomy	16,706	90	1971	88.0	77.8	71.2	66.4	63.0	0.4	176	447	1137	765	35	7978	927	334	950	506
Thora-colapa-rotomy	153	1	19	80.8	64.4	46.2	42.9	38.4	4.3	6	15	12	17	0	41	12	6	8	6
Laparo-scopie	7638	9	1036	97.7	95.4	92.6	90.3	88.1	0.4	14	29	102	82	3	5236	46	124	282	102
Others	48	0	8	85.4	79.1	79.1	74.6	72.1	6.6	0	4	3	2	0	27	0	0	3	1
Operative procedure (resected cases)																			
Distal gastrec-tomy	14,641	46	1902	93.5	87.4	83.1	79.5	76.8	0.4	105	250	493	407	11	8585	397	278	653	328
Total	8087	40	917	85.3	73.6	65.9	60.7	56.9	0.6	84	235	746	437	25	3493	558	139	510	248
Proximal gastrec-tomy	863	7	106	94.3	89.0	84.5	81.0	78.2	1.5	5	8	8	17	2	523	25	23	51	22
Pylorus-pre-serving gastrec-tomy	650	0	55	99.8	99.5	98.3	97.6	96.6	0.8	1	0	2	2	0	538	0	4	6	5
Local/segmental resection	298	7	54	92.5	86.0	78.1	74.9	70.0	3.0	1	2	5	3	0	138	5	19	23	12
Mucosal resection	6	0	0	83.3	83.3	83.3	83.3	83.3	15.2	0	0	0	0	0	5	0	1	0	0
Lymph node dissection (D) (resected cases)																			
D0	975	22	134	71.3	60.0	53.7	50.3	47.0	1.8	18	29	61	36	2	314	139	30	75	42
D1	3412	30	524	83.6	74.2	69.0	64.9	61.2	0.9	22	54	187	92	4	1479	279	75	256	141
D1+	8712	16	1096	95.2	90.4	86.7	83.6	81.3	0.5	44	83	211	167	10	5512	165	178	402	156
D2	10,559	26	1168	92.0	83.1	76.3	71.7	68.4	0.5	102	295	725	520	20	5586	340	170	458	248
D2+	563	3	63	88.8	76.9	70.9	64.1	60.7	2.2	5	24	49	37	2	266	30	4	30	11
Combined resection (resected cases)																			
-	16,805	63	2180	92.6	86.0	81.5	78.1	75.4	0.4	112	265	646	440	16	9706	556	316	719	396

Table 3 (continued)

Categories	Total number	Direct death	Lost f.u.	Postoperative survival rate (%)					S.E. at 5 yr	Site of recurrence				Cause of death					
				1 yr	2 yr	3 yr	4 yr	5 yr		L	LN	P	H	R	Alive	PD	OC	OD	UK
+	7734	37	852	87.5	77.3	70.0	64.4	60.7	0.6	84	230	608	425	22	3574	429	148	336	218
Combined resected organ (resected cases)																			
Pancreatic tail	298	3	33	74.8	57.0	50.9	44.6	41.6	3.1	5	18	44	24	3	96	25	2	25	6
Spleen	1693	5	156	86.1	73.5	64.4	58.2	53.6	1.3	28	68	196	142	9	703	78	20	93	37
Transverse colon	158	3	16	70.8	57.8	49.5	41.5	41.5	4.2	3	4	35	8	0	50	20	1	8	2
Transverse mesocolon	88	3	10	73.6	58.0	47.4	37.9	33.4	5.5	4	5	18	6	0	20	7	2	5	4
Dia-phragm	18	0	2	77.1	65.3	65.3	52.2	52.2	12.3	0	0	2	2	0	8	4	0	0	0
Thoracic esophagus	83	0	11	75.8	59.4	40.6	34.7	31.5	5.6	1	8	4	11	2	19	9	7	7	1
Liver	175	1	17	78.9	64.1	54.7	46.9	45.4	4.1	1	5	12	23	0	62	24	4	8	7
Gall bladder	4959	22	573	90.3	81.7	75.2	70.3	66.7	0.7	39	115	284	203	7	2502	240	98	255	152
Adrenal gland	10	0	1	88.9	88.9	88.9	88.9	88.9	10.5	0	0	0	0	0	7	0	0	0	1
Kidney	17	0	3	100	100	100	84.6	84.6	10.0	0	0	1	0	0	10	1	0	0	0
Small intestine	46	1	8	67.1	61.9	56.4	56.4	56.4	7.8	1	1	1	1	1	18	6	1	5	1
Abdominal wall	8	0	1	75.0	62.5	50.0	37.5	37.5	17.1	0	0	1	1	0	2	1	0	1	1
Ovary	19	0	2	88.6	76.4	63.6	63.6	57.3	12.3	0	0	3	1	0	9	3	0	0	0
Appleby's operation	3	0	0	66.7	33.3	33.3	33.3	33.3	27.2	0	0	0	0	0	1	0	1	0	1
Pancreaticoduodenectomy	39	0	5	83.6	71.8	53.1	53.1	43.1	8.7	0	2	3	1	0	13	5	5	3	0
Others	120	2	14	91.2	88.1	72.4	66.9	62.3	5.0	2	4	4	2	0	54	6	7	6	5
Involvement of the resection margin (resected cases)																			
PM- and DM-	23,759	85	2953	91.9	84.5	79.3	75.3	72.3	0.3	164	464	1123	820	31	13,134	822	451	1199	581

Table 3 (continued)

Categories	Total number	Direct death	Lost f.u.	Postoperative survival rate (%)					S.E. at 5 yr	Site of recurrence				Cause of death						
				1 yr	2 yr	3 yr	4 yr	5 yr		L	LN	P	H	R	PD	OC	OD	UK		
PM+ and/or DM+	628	11	64	60.1	40.3	29.3	24.1	20.2	1.8	29	29	120	38	6	90	143	5	29	28	
Residual tumor (resected cases)																				
R0	21,928	60	2773	94.6	88.8	83.9	80.1	77.0	0.3	130	351	733	662	26	12,988	353	442	1106	516	
R1	1209	13	113	70.0	45.1	32.4	25.3	21.4	1.3	35	68	286	100	3	186	190	11	62	44	
R2	1259	25	128	48.8	24.5	16.0	12.1	9.4	1.0	29	69	227	96	7	74	413	9	60	46	

Unknown cases were excluded

*Direct death* direct death within 30 postoperative days, *Lost f.u.* lost to follow-up, *SE* standard error, *L* local, *LN* lymph node, *P* peritoneum, *H* liver, *R* recurrence at known site, *PD* primary disease, *OC* other cancer, *OD* other disease, *UK* unknown, *PM* proximal margin, *DM* distal margin, *R0* no residual tumor, *R1* microscopic residual tumor (positive resection margin or CY1), *R2* macroscopic residual tumor

pylorus preserving gastrectomy, segmental gastrectomy, and local gastrectomy (including wedge resection), were recorded in the NCD database at 2011 [9]. In the NCD gastric cancer registry, the 24,539 resected cases with the above procedures covered 44.4% of stomach surgeries. The number of enrolled cases in gastric cancer registry accounted for less than half of stomach surgeries in NCD. The difficulty in achieving complete enumeration of all cancer patients is a major issue in organ-specific cancer registries. So far, the conventional JGCA registry has been voluntarily supported by the hospitals to which JGCA members belong, and so the increase in the number of participating hospitals has limitations. The launch of the NCD cancer registry has been widely announced to all hospitals that participated in the NCD surgery registry, as well as the 199 hospitals (39.7%) that newly participated in the initial NCD gastric cancer registry in addition to 302 conventional hospitals (60.3%). The NCD database showed high similarity to the conventional JGCA registry database [1]. The NCD cancer registry, which used a new registry system, demonstrated the validity of database construction. The NCD registry can be expected to expand the range of the gastric cancer registry and increase the number of hospitals participating in the cancer registry.

Another issue raised in the initial registry was the quality assurance of the registration data. An audit of the registration data of the gastroenterological surgeries in the NCD was started in 2015, and high accuracy of data entry has been proved through quality verification [14]. With regards to gastric cancer registry in the NCD, registrants failed to finish or approve data entry in 8.8% of all recorded cases, and did not enter follow-up data in 1.2% of the approved cases. These data deficiencies are also a limitation of this study. An entry system needs to become well known and should be modified for its easy-to-use application through validation by an audit. The complementary integration and reorganization of registry systems between organ-specific cancer registries containing detailed data about tumor status and other cancer registries containing prognostic information is required for conducting an accurate and reliable nationwide cancer database. If all the above-mentioned surgeries registered in the NCD are enrolled in the gastric cancer registry and provided prognostic information, complete enumeration of all stomach surgeries patients is possible.

In conclusion, the NCD registry system of gastric cancer demonstrated the validity of database construction. This program is expected to provide a new comprehensive cancer database integrating patient demographics, oncological features, and therapeutic outcomes with the optimization of data entry system. Therefore, the NCD registry system may offer useful information to further

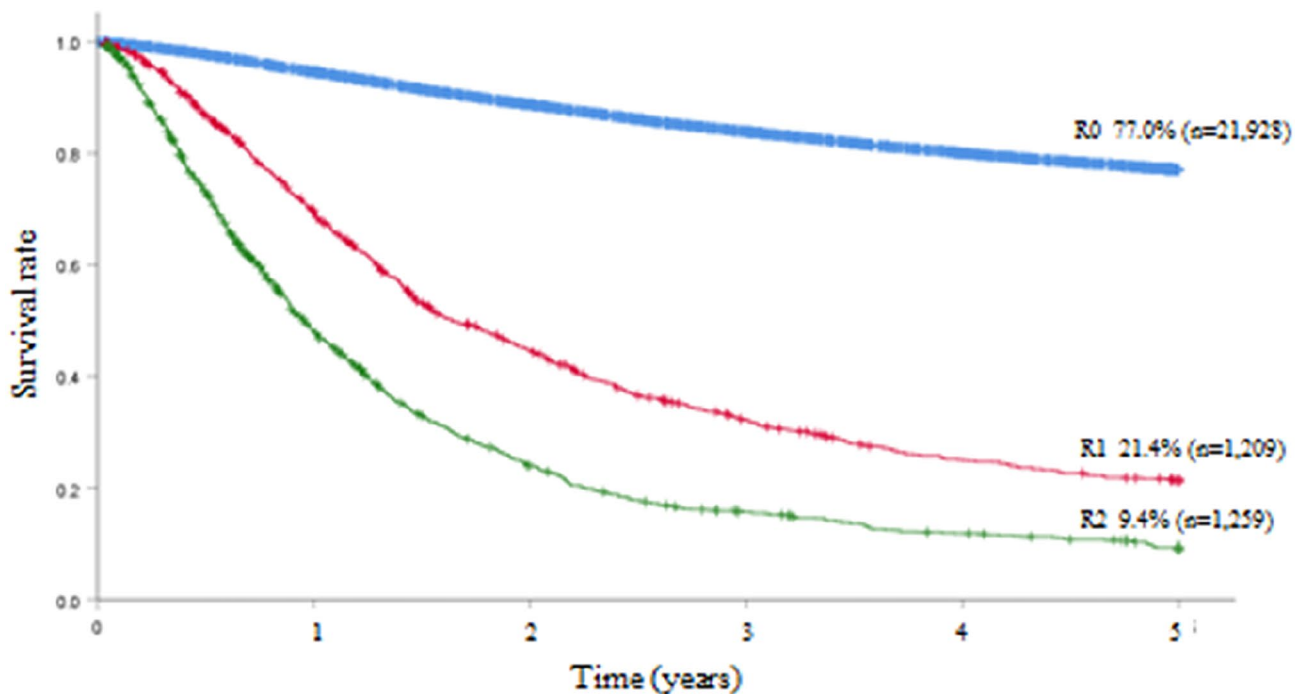


Fig. 3 Kaplan–Meier survival curves of patients stratified to residual tumor

develop gastric cancer research, and provide high-quality treatment.

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**The Registration Committee of the Japanese Gastric Cancer Association** Satoshi Suzuki, Takashi Ishikawa, Kohei Akazawa, Hitoshi Katai, Yoh Isobe, Isao Miyashiro, Hiroyuki Ono, Satoshi Tanabe, Takeo Fukagawa, Kei Muro, Souya Nunobe, Shigenori Kadowaki, Haruhisa Suzuki, Tomoyuki Irino, Yoshihiro Kakeji

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## Declarations

**Conflict of interest** Arata Takahashi, Shiyori Usune, and Hiroaki Miyata are affiliated with the Department of Healthcare Quality Assessment at the University of Tokyo. The department is a social collaboration department supported by grants from the National Clinical Database, Johnson & Johnson K. K., and NIPRO Co. The other authors have no conflict of interest to declare.

**Human rights statement** All procedures were performed in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national), as well as with the Helsinki Declaration of 1964 and later versions. The gastric cancer registration program of the NCD was approved by the Institutional Review Board of the Graduate School of Medicine, Kobe University.

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