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Survival Rates of Childhood Cancer Patients in Osaka, Japan, 1975–1984

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Survival rates for childhood cancers were analyzed with a total of 2,209 cases who were registered in a population-based cancer registry in Osaka, Japan in 1975–1984. These cases were reclassified according to Birch's classification and the survival rate of each diagnostic group was calculated by Kaplan-Meier methods. Death certificate-only cases, which amounted to 3.9% of all incidence, were excluded from the calculation. The five-year cumulative survival rate for both sexes was 46% for all cancer children. Among 12 major diagnostic groups, the most favorable survival was seen in retinoblastoma (87.5%), followed by renal tumors, epithelial neoplasms, and gonadal and germ-cell tumors. The outcome was unfavorable in leukemias, sympathetic nervous system tumors, hepatic tumors and malignant bone tumors. Comparing the survival in 1975–1979 with that in 1980–1984, the rate for all childhood cancer rose from 41% to 51%. Improvement in survival was also observed in 4 groups; acute lymphocytic leukemia, acute non-lymphocytic leukemia, non-Hodgkin's lymphoma and osteosarcoma. One attributable factor for the rise of survival was proved to be improvement of medical treatment by Cox's hazard model analysis. Comparison of survival rates in Osaka with those in England and the U.S. revealed that the prognosis for acute lymphocytic leukemia and acute non-lymphocytic leukemia was less favorable in Osaka than in England and the U.S.

Key words: Childhood neoplasm — Survival — Time trend — Population-based cancer registry

In Japan, cancer is the leading cause of death from disease in children under the age of 15. Survival rates for childhood cancer in Japan have been reported based on chinical trials or hospital-based data.[1,2] However, these figures might be higher than those for all incident cases in the general population, because the 33 hospitals which appeared in these papers have been participating in the Japan Children's Cancer Registry as regional childhood cancer treatment centers in various areas in Japan, and these hospitals might offer more comprehensive medical treatments than those in other general hospitals. Furthermore, the incidence rate of childhood cancer is much less than that in adults,[3] so the previous results from hospital-based studies have broad confidence intervals. Only a population-based cancer registry with a large population and a long history can offer reliable survival rates comparable with those reported from foreign population-based registries.[4–9]

Previously, we reported the incidence and the trends of childhood cancer in the period of 1971–1988 using the data from the Osaka Cancer Registry.[3] In this study, we analyzed survival rates and the trends among childhood cancers registered in the Osaka Cancer Registry in 1975–1984 according to Birch's classification,[10] and compared the results with those observed in England and the U.S. This is the first report on the survival rates for childhood cancer in Japan using population-based data.

MATERIALS AND METHODS

Subjects Data for this analysis were obtained from the Osaka Cancer Registry, a population-based registry covering Osaka Prefecture, Japan, with a population of 8.7 million in the 1990 census. Cases were aged 0–14 years and resident in Osaka Prefecture at the time of diagnosis. Among 2,298 patients diagnosed in 1975–1984, 89 cases (3.9%) were registered by death certificate only (DCO). After removing DCO cases, a total of 2,209 patients were included in this analysis. Microscopically confirmed cases amounted to 80.2% of subjects.

Follow-up In order to confirm the death of cancer patients, all registered cases have been annually collated with death certificates of all causes for all inhabitants of Osaka Prefecture. Further follow-up was performed for those patients for whom no death certificate had been issued in the 5 years following diagnosis. The Statistical Officers working in the 30 prefectural and municipal health centers visited city offices and searched the citizen's register for these patients' names. If the patients had moved out of the city, a questionnaire was sent to the city office corresponding to the new address. Cases lost in follow-up amounted to 104 patients, or 4.7% of total cases. These cases were treated as censored cases at the most recent date for which medical information was available in the registry, such as date of operation or recurrence.

Analysis Cancer cases were reclassified into 12 major diagnostic groups and minor diagnostic groups according to Birch's classification as shown in Table I, using the information on clinical diagnosis, morphology (ICD-O-M) and topology (ICD-9).[3, 10–12] Minor diagnostic groups were also included in the analysis when the number of cases was 10 or more in that subgroup.

Survival rates were calculated using Kaplan-Meier methods for the total observation period (1975–1984) and for the first and second 5-year periods (1975–1979 and 1980–1984). The difference in survival curves between the two 5-year periods was assessed using the log rank test. Effects of sex, age, and clinical stage on prognosis were examined by using Cox's proportional hazard model for all minor diagnostic groups with a significant difference in survival. The SAS statistical package was used for these analyses.[13]

RESULTS

Five-year survival rates in 1975–1984 by diagnostic group Table I shows the numbers of cases observed and the 5-year cumulative survival rates with their 95% confidence intervals for 1975–1984. Table I also shows the 5-year survival rates for 1975–1979 and for 1980–1984, and the *P*-values of the log rank test for the difference between these two periods according to diagnostic group. The 5-year survival rate for all cancer cases was 45.7% in 1975–1984.

Among the 12 major diagnostic groups, the most favorable survival was shown in retinoblastoma (87.5%), followed by renal tumors, epithelial neoplasms, and gonadal and germ-cell tumors (more than 60%). The lowest survival was seen in the group of leukemias (31.2%), followed by sympathetic nervous system (SNS)

Table I. Five-year Cumulative Survival Rates and Their Time Trends for Childhood Cancer Patients in Osaka, 1975–1984, for Both Sexes

Diagnostic group	No. of cases	5-year survival rate (%)			Log rank test
		1975–84 (95%CI[a])	1975–79	1980–84	
I. Leukemias	734	31.2 (27.8–34.6)	23.4	38.7	<0.0001
Acute lymphocytic leukemia (ALL)	459	38.7 (34.2–43.3)	33.0	43.8	0.04
Acute non-lymphocytic leukemia (ANLL)	176	14.1 (8.8–19.3)	3.6	24.9	<0.0001
Chronic myeloid leukemia	25	18.0 (2.1–33.8)	0.0	15.0	0.96
II. Lymphomas and other reticulo-endothelial neoplasms	226	43.7 (37.1–50.2)	34.7	50.3	0.02
Hodgkin's disease	18	77.8 (58.6–97.0)	—	—	
Non-Hodgkin lymphoma (NHL)	107	42.8 (33.2–52.4)	25.0	56.0	<0.01
III. Central nervous system (CNS) neoplasms	472	51.6 (47.0–56.2)	48.0	55.3	0.18
Ependymoma	28	57.1 (38.8–75.5)	69.2	46.7	0.16
Astrocytoma	73	52.7 (41.0–64.4)	58.7	48.3	0.49
Medulloblastoma	50	8.6 (0.6–16.7)	8.7	8.6	0.90
Other glioma	28	29.3 (9.6–49.0)	28.1	27.5	0.89
Other and unspecified	293	59.7 (54.0–65.4)	51.3	69.6	<0.01
IV. Sympathetic nervous system (SNS) tumors	146	37.5 (29.3–45.7)	44.4	26.2	0.06
Neuroblastoma	144	37.0 (28.8–45.2)	43.7	26.2	0.07
V. Retinoblastoma	93	87.5 (80.6–94.5)	89.7	84.9	0.47
VI. Renal tumors	80	68.7 (58.3–79.1)	64.9	73.0	0.52
Wilms' tumor	69	64.9 (53.3–76.5)	62.7	67.7	0.77
VII. Hepatic tumors	47	38.3 (24.4–52.2)	38.5	38.1	0.82
Hepatoblastoma	30	40.0 (22.5–57.5)	43.8	35.7	0.83
VIII. Malignant bone tumors	74	41.1 (29.4–52.9)	20.4	54.3	<0.01
Osteosarcoma	49	38.3 (24.1–52.5)	17.7	50.8	0.02
Ewing's sarcoma	14	31.0 (5.8–56.1)	—	—	
IX. Soft-tissue sarcomas	103	57.3 (47.4–67.1)	60.5	54.5	0.54
Rhabdomyosarcoma	55	45.7 (32.2–59.1)	50.7	41.5	0.38
Fibrosarcoma	20	88.9 (74.4–103.4)	—	—	
X. Gonadal & germ-cell tumors	153	64.2 (56.2–72.2)	58.2	69.0	0.26
Non-gonadal germ-cell tumors	62	57.2 (43.9–70.6)	49.1	63.6	0.39
Gonadal germ-cell tumors	61	68.0 (55.8–80.2)	62.9	72.5	0.45
XI. Epithelial neoplasms	37	64.4 (48.1–80.7)	56.6	69.6	0.60
XII. Other and unspecified	44	51.6 (36.3–66.8)	35.7	85.1	<0.01
All cancers	2,209	45.7 (43.6–47.8)	40.8	50.5	<0.0001

Survival rates are not shown when numbers of cases are less than 10.
a) The 95% confidence intervals for survival rates in 1975–84.

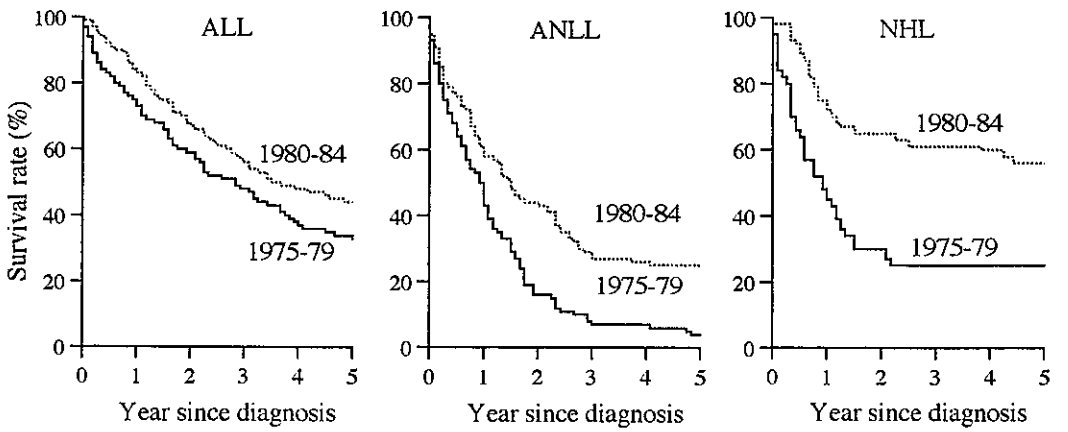

Fig. 1. Survival curves for ALL, ANLL, and NHL in Osaka by year at diagnosis.

tumors (37.5%), hepatic tumors (38.3%), and malignant bone tumors (41.1%).

The prognosis varied by minor diagnostic group in some major diagnostic groups. Among leukemias, the survival rate was higher in acute lymphocytic leukemia (ALL, 38.7%) than in acute non-lymphocytic leukemia (ANLL, 14.1%) or chronic myeloid leukemia (18.0%). The prognosis in Hodgkin's disease (77.8%) was markedly higher than that in non-Hodgkin lymphoma (NHL, 42.8%). Survival rates of minor groups in central nervous system (CNS) neoplasms ranged between 8.6% and 59.7%. In the group of soft-tissue sarcoma, the survival rate was less favorable in rhabdomyosarcoma (45.7%) than in fibrosarcoma (88.9%), which was the most favorable among all minor diagnostic groups shown in Table I.

Comparison of 5-year survival rates between 1975–1979 and 1980–1984 by diagnostic group Five-year survival rate for all cancer cases has improved significantly from 40.8% in 1975–1979 to 50.5% in 1980–1984 (Table I).

Comparing the survival rates for each major diagnostic group in the first and the second period, significant improvement was observed in leukemias (from 23.4% to 38.7%), lymphomas (from 34.7% to 50.3%), and malignant bone tumors (from 20.4% to 54.3%). In SNS tumors, survival rates were less favorable in the second period (26.2%) than in the first period (44.4%), although this was not statistically significant. Prognosis in other major groups did not show any significant change between these periods.

Figs. 1 and 2 show survival curves of the minor diagnostic groups with marked changes in these periods: ALL, ANLL, NHL, neuroblastoma, and osteosarcoma. The differences in the 4 groups other than neuroblastoma were statistically significant.

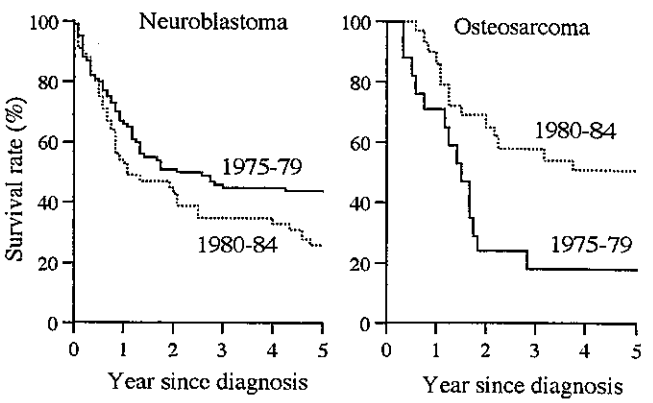

Fig. 2. Survival curves for neuroblastoma and osteosarcoma in Osaka by year at diagnosis.

Survival rates in ALL, ANLL, and NHL improved greatly in the second period (Fig. 1), and this accounts for a large part of the improvement in survival rate for all cancer cases.

The survival rate in neuroblastoma, which accounted for most of the SNS tumors, showed a downward trend in the second period (from 43.7% to 26.2%, $P=0.07$, in Fig. 2), though the difference was not statistically significant.

The prognosis of osteosarcoma improved in the second period (Fig. 2). An improvement was also observed in Ewing's sarcoma, although this is not shown because of the small number of cases; 5 in the first period and 9 in the second. All of the 5 Ewing's sarcoma diagnosed in the first period died within 44 months after diagnosis, while 3 of the 9 diagnosed in the second period have survived more than 60 months.

Table II. Distribution of Clinical Stage and 5-Year Survival Rates by Clinical Stage

Diagnostic group	Percent of stage unspecified	Distribution (%)[a]			Survival rate (%)			
		L	R	D	L	R	D	U
II. Lymphomas	56	9	14	77	87.5	28.6	28.6	51.7
III. CNS neoplasms	70	88	8	4	39.9	12.1	16.7	57.7
IV. SNS tumors	48	17	29	54	80.0	27.8	6.1	52.0
V. Retinoblastoma	63	85	9	6	95.8	100.0	50.0	84.5
VI. Renal tumors	48	50	26	24	78.6	90.9	40.0	64.5
VII. Hepatic tumors	68	33	20	47	60.0	0.0	14.3	43.8
VIII. Malignant bone tumors	36	47	21	32	53.6	33.8	13.3	51.0
IX. Soft-tissue sarcomas	61	48	20	33	72.2	28.6	30.8	61.6
X. Gonadal & germ-cell tumors	48	54	18	28	78.0	25.0	31.8	74.3
XI. Epithelial neoplasms	38	61	17	22	81.5	50.0	20.0	69.2

L, localized; R, regional; D, distant; U, unspecified (refer to the text).
a) Distribution among cases after excluding 'unspecified' (L+R+D=100%).

Five-year survival rates by clinical stage Table II shows the distribution of clinical stage at the date of diagnosis and the 5-year survival rates in each stage for 1975–1984 according to major diagnostic group. Clinical stage has been classified in Osaka into the following categories: 1) tumors confined to the original organ (localized, L), 2) tumors extending directly into surrounding organs or tissues or having metastasis into regional lymph nodes (regional, R), 3) tumors which spread to distant organs or tissues (distant, D), and 4) the extent of disease is unspecified (unspecified, U). Leukemias were excluded from this analysis, since they were all classified as 'distant.'

The proportion of 'unspecified' was 58% for all cancer cases, varying from 36% to 70% by diagnostic group. Proportions designated 'localized' cases, after excluding 'unspecified' ones, were more than 80% in CNS neoplasms and retinoblastoma, and less than 40% in lymphomas, SNS tumors, and hepatic tumors.

Survival rates also varied by clinical stage and by diagnostic group: survival rates of localized cases were 70% or over in all groups other than 3; CNS neoplasms, hepatic tumors, and malignant bone tumors. Survival rate for CNS neoplasms was 40% even though they were in a localized stage.

Proportions of 'stage unspecified' cases in all major diagnostic groups were relatively high, and their survival rates were high, being intermediate between the survival rates of 'localized' cases and those of 'regional' cases in most major diagnostic groups (Table II). Estimated survival rates for cases with definite staging became lower than those for cases including these 'unspecified cases' in most major groups.

Effects of sex, age, year at diagnosis, and clinical stage on survival Table III shows the 5-year survival rates and hazard ratios with 95% confidence intervals according to sex, age, year at diagnosis, and clinical stage for each of 5 diagnostic groups; 4 subgroups showing significant improvement in survival in the second period, ALL, ANLL, NHL, and osteosarcoma, and 1 subgroup, neuroblastoma, had an insignificant downward trend in survival in the latter period.

Females had higher survival rates than males for each of these 5 groups, although none of them showed a significant hazard ratio. Significant difference in survival by age was observed for ALL and for neuroblastoma. Survival rates were higher for ALL patients aged 2–4 and 5–9 than those aged 0–1 and 10–14, and for neuroblastoma patients aged 0–1 than those aged 2–14. Clinical stage had an important effect on survival for osteosarcoma and neuroblastoma.

Year at diagnosis remained a significant prognostic factor for each of the 4 subgroups (ALL, ANLL, NHL, and osteosarcoma), even after controlling other factors. The hazard ratio of the second period to the first period was significantly less than 1.00 in each of these 4 diagnostic subgroups (from 0.41 to 0.75).

The effect of year at diagnosis, however, disappeared in neuroblastoma after controlling for sex, age, and clinical stage (1.04). Prognosis in neuroblastoma was significantly less favorable for children aged 2–14 than those aged 0–1 and for children with distant metastasis than those with localized tumors. The numbers of neuroblastoma cases designated 'localized,' 'regional,' 'distant,' and 'unspecified' were 11, 8, 20, and 47 in the first period, and 2, 14, 21, and 21 in the second period, respectively. The proportion of 'localized' was smaller and that of 'distant' was greater in the second period. The distribution of neuroblastoma patients by sex and age did not change during these two periods.

Comparison with England and the U.S. Table IV shows 5-year survival rates and numbers of cases observed in the Manchester Children's Tumor Registry in England[7]

Table III. Survival Rates and Hazard Ratios by Sex, Age, Year at Diagnosis and Clinical Stage, Cox's Proportional Hazard Model, Multivariate

Diagnostic group	Factor		No. of cases	Survival rate	Hazard ratio (95%CI)
ALL	Sex	Male	262	37.3	1.00
		Female	197	40.6	0.83 (0.66–1.05)
	Age	0–1	47	29.8	1.00
		2–4	154	44.3	0.57 (0.39–0.85)
		5–9	180	39.4	0.66 (0.45–0.96)
		10–14	78	31.9	0.95 (0.62–1.44)
	Year	1975–79	216	33.0	1.00
		1980–84	243	43.8	0.75 (0.60–0.94)
ANLL	Sex	Male	97	13.1	1.00
		Female	79	15.3	1.08 (0.78–1.50)
	Age	0–4	57	17.0	1.00
		5–9	61	13.3	1.07 (0.72–1.60)
		10–14	58	12.3	1.19 (0.80–1.77)
	Year	1975–79	90	3.6	1.00
		1980–84	86	24.9	0.54 (0.39–0.75)
NHL	Sex	Male	75	40.3	1.00
		Female	32	48.4	0.82 (0.46–1.45)
	Age	0–4	36	44.0	1.00
		5–9	32	40.9	1.13 (0.60–2.14)
		10–14	39	43.1	1.27 (0.70–2.30)
	Year	1975–79	44	25.0	1.00
		1980–84	63	56.0	0.44 (0.27–0.73)
Osteosarcoma	Sex	Male	27	22.6	1.00
		Female	22	54.6	0.52 (0.24–1.12)
	Age	5–9	12	45.5	1.00
		10–14	37	35.8	0.80 (0.32–2.00)
	Year	1975–79	18	17.7	1.00
		1980–84	31	50.8	0.41 (0.18–0.93)
	Stage	Localized	18	55.0	1.00
		Regional	9	37.5	1.47 (0.45–4.77)
		Distant	10	10.0	3.16 (1.14–8.75)
		Unspecified	12	41.7	1.41 (0.47–4.20)
Neuroblastoma	Sex	Male	84	26.6	1.00
		Female	60	51.8	0.70 (0.44–1.13)
	Age	0–1	53	68.2	1.00
		2–14	91	19.8	2.59 (1.48–4.56)
	Year	1975–79	86	43.7	1.00
		1980–84	58	26.2	1.04 (0.66–1.63)
	Stage	Localized	13	80.0	1.00
		Regional	22	27.8	4.11 (0.89–18.96)
		Distant	41	6.1	6.42 (1.49–27.65)
		Unspecified	68	51.3	2.71 (0.64–11.43)

and the SEER program in the U.S.[5] Diagnostic groups were included in this table when comparable figures to those in Osaka were available in both England and the U.S. The prognosis and the incidence of CNS neoplasms by minor group were not compared since histologically unspecified CNS neoplasms occupied more than 60% in Osaka. The symbols ↑ and ↓ were attached to the figures from England and the U.S. when their survival rates were higher or lower, respectively, than the upper or the lower limit of 95% confidence intervals of survival rates in Osaka. Statistical significance could not be tested because of the lack of confidence intervals in the reference.

Survival rates for ALL and ANLL were lower in Osaka than those in both England and the U.S. Survival rate in Osaka for neuroblastoma was lower than the U.S. but higher than England. Other groups showed similar survival rates in the three countries, except retinoblastoma (Osaka > England) and gonadal and germ cell tumors (Osaka < the U.S.).

Table IV. Survival Rates and Numbers of Cases of Childhood Cancer in Osaka, England, and the U.S.

Diagnostic group	Survival rate (%)			No. of cases		
	Osaka	England	U.S.	Osaka	England	U.S.
ALL	39	47 ↑	59 ↑	459	251	1,170
ANLL	14	21 ↑	20 ↑	176	45	213
Hodgkin's disease	78	91	84	18	37	301
NHL	43	46	51	107	51	346
CNS neoplasms	52	—	52	472	—	1,014
Neuroblastoma[a)]	37	28 ↓	50 ↑	144	54	406
Retinoblastoma	88	72 ↓	88	93	18	147
Wilms' tumor[b)]	65	85 ↑	76	69	48	316
Osteosarcoma	38	39	43	49	26	131
Ewing's sarcoma	31	41	48	14	17	106
Rhabdomyosarcoma	46	54	54	55	31	172
Gonadal & germ cell	64	64	86 ↑	153	37	101

Osaka (1975–84), England (1974–83),[7)] U.S. (1973–81).[5)]
a) SNS tumors in the U.S.
b) Renal tumors in the U.S.
Symbols ↑ and ↓ represent higher or lower survival rates, respectively, in England or the U.S. than the upper or the lower limit of 95% confidence intervals of survival rate in Osaka.

DISCUSSION

The national mortality rate of childhood cancer in Japan adjusted to the world population was more than 55 per million in 1960–75, and decreased to 49, 40, and 35 in 1980, 1985, and 1988, respectively. Since the incidence rate for childhood cancer has significantly increased in 1981–1988 from that in 1971–1980 in Osaka,[3)] it seems to be appropriate to attribute the cause of the decrease in mortality to improvements in survival. Therefore, data on mortality are losing their validity as an index by which to measure the extent of the problem of childhood cancer within the community.

This study showed that survival rates varied by major diagnostic group and by minor diagnostic group even within the same group. Therefore, survival rates and their trends should be estimated by minor diagnostic group. The incidence rate of childhood cancer is very low: the crude rate in this study was only 113 per million children. In addition, 65% of childhood cancers were accounted for by only 3 major diagnostic groups, i.e. leukemias, lymphomas, and CNS neoplasms. This implies that the incidence rates of other minor diagnostic groups were extremely low. Survival rates by minor diagnostic group can be calculated only by using data from a long-term and large-sized population-based cancer registry such as the Osaka Cancer Registry.

Although cumulative survival rates were calculated and shown in this study, it should be noted that they were almost the same as relative survival rates, since expected survival rates were higher than 99% for children aged 0–14. Survival rates for all cancer patients rose from 41% in 1975–1979 to 51% in 1980–1984. Significant improvement in survival rates was also observed in ALL, ANLL, NHL, and osteosarcoma in univariate as well as multivariate analysis. The values of hazard ratios in Table III proved the improvement in survival to have been caused by the improvement in methods of therapeutic treatment. Although survival rates by detailed method of treatment were not observed in this study, the distribution of cases who received surgical operation, radiotherapy, and/or chemotherapy was different in the second period: the proportion of ALL patients who received radiotherapy increased from 46% to 70%, and that of NHL patients who received surgical operation increased from 48% to 67%. It appears that these changes in medical treatment improved the survival rates. Meanwhile, the observed improvement in the survival for major diagnostic groups may be partly attributable to the relative decrease in the proportion of cancer cases with unfavorable survival rates, such as cases with more malignant histological types, less favorable biologic prognostic factors, etc. However, these points could not be examined in this study because of the shortage of detailed medical information in their cancer reports.

On the other hand, the downward trend in the survival rate for neuroblastoma patients disappeared when the effects of sex, age, and clinical stage were controlled. Prognosis in neuroblastoma was less favorable among children of a higher age (2–14) and also with more advanced staging in this study, as well as in the previous report.[14)] It is increasingly assumed that there are two biologically distinct types of neuroblastoma; one is an inherently good prognosis group which is diagnosed up

to 1 year of age, and the other is an unfavorable prognosis group which rapidly multiplies after 1 year of age.[15] The lower survival in the second period in this study was proved to be caused by a greater proportion of remote metastasis cases. The reason for this change is unclear at present. In Osaka, more than half of infants have undergone the screening test for neuroblastoma since 1985, and the effect of the screening test does not appear in this study. Trends in survival rates for neuroblastoma patients should be carefully monitored hereafter.

Sex and age were likely to have some effects on prognosis for these 5 groups. Females had higher survival rates than males for all these groups, although the differences were not statistically significant. Moreover, the prognosis for ALL was statistically less favorable for patients aged 0–1 and 10–14 than those aged 2–9 in this study. Steinherz *et al.* identified a subgroup of patients with ALL who were at a higher risk of treatment failure than any other high-risk subgroups of ALL patients except for infants, and showed its clinical feature of male predominance and older age.[16] More favorable prognosis for females than males in osteosarcoma was also reported, although the reason for this sex difference is unclear.[17]

Comparison of survival rates in Osaka with those in England and the U.S. showed a less favorable prognosis for ALL and ANLL in Osaka. In England, a large part of the improvement in survival rate for childhood cancer, especially for leukemias, is attributed to 'centralization of care,' or the increase in the proportion of children who received medical treatment at specific centers.[6, 7, 9] In 1974–1983 in England, 90% of ALL patients received their medical treatments in childhood cancer centers.[7] In Japan, the survival rates for ALL reported from clinical trials[1] and from children's hospitals[2] were higher than those in this study. However, children who received medical treatment at these regional centers accounted for only 63% of the estimated incidence of leukemias in 1979–1983 in Japan.[3] A part of the difference in survival rates between Osaka and England might be explained by differences in the extent of 'centralization of cancer patients,' although no information has thus far been obtained on the effect of 'centralization' in the U.S.

Meanwhile, the ALL/ANLL incidence ratio was 2.6 in Osaka, and more than 5.0 in England and in the U.S. as shown in Table IV. The histological distribution in the same minor diagnostic group might be different between Osaka and white populations, which might imply a lower survival for ALL and ANLL in Osaka.

Survival rates calculated using data from a population-based registry might be useful as an index of medical care for children in the community. Continuous estimation of incidence and survival for childhood cancer using population-based data is essential for health care planning for children.

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