REGULAR ARTICLE

Cancer understanding among Japanese students based on a nationwide survey

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Abstract

Objective The objective of this study was to determine cancer understanding among Japanese primary and secondary school students.

Methods The study design was a cross-sectional nationwide survey using a self-administered questionnaire. The prefecture with the lowest student population was set to 1, and that with the highest student population was set to 18 for elementary schools and 19 for junior high and high schools based on the ratio of the student population. In this way, 213 elementary schools, 222 junior high schools, and 208 high schools were selected from all 47 prefectures in Japan, and questionnaires were sent to each school. The questionnaire listed the names of 15 cancers and asked respondents to choose one answer from three: "Never heard of," "Heard of/ Don't understand," or "Heard of/Understand."

Results Response rates for schools were 44.1 % (n = 94) for elementary schools, 46.4 % (n = 103) for junior high schools, and 55.8 % (n = 116) for high schools. A total of 8,876 questionnaires were used for the analysis. Our survey suggests that the most commonly understood types of cancer differed by grade, with lung cancer the most commonly understood in elementary school, leukemia in junior high schools, and breast cancer in high schools. Girls tended to demonstrate greater cancer understanding than boys, with particularly large differences by gender in rates of understanding of breast and uterine cancer at each assessed grade level.

Conclusions Here, we examined Japanese primary and secondary school students. Marked differences in cancer recognition by grade and gender suggest that educational efforts are needed at various grade levels and gender-specific cancer education. Further, more than 50 % of students at any school level were not familiar with most cancers. It suggests that cancer education is deficient.

Keywords Cancer understanding · Cancer knowledge · Students · Nationwide survey

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Introduction

A total of 12.66 million new cases of cancer were estimated to have developed worldwide in 2008 with 7.56 million deaths occurring [1]. In Japan, cancer has been the leading cause of death since 1981; in 2012, approximately 361,000 persons died from cancer with cancer mortality rates of 350.8 for males and

225.7 for females (per 100,000 population) [3–5]. Further, approximately 30 % of Japanese adults die of cancer [2]. While rank order has shifted, the five cancer sites responsible for the greatest mortality and incidence have not changed drastically for 60 years. Causes of cancer and modifiable risk factors have been reported in recent studies [6–9]; however, while prevalent and high-risk cancers represent important targets of preventive public health efforts and understanding of the etiology and risk factors associated with many cancers has improved, cancer screening rates remain low [2, 10]. In addition, disease stigma and discrimination against cancer patients or their family members are important barriers to address through education. While improving cancer awareness from a young age through education is expected to help attenuate the negative effects of stigma and discrimination while improving screening rates, the established national curriculum has featured few such educational opportunities.

At present, educational material regarding cancer may be found only at the high school level in the Japanese school system, with elementary and junior high school health textbooks focusing more on prevention of other lifestyle-related diseases [11–14]. Development of cancer education modules for school children is therefore one critical issue; however, basic understanding regarding cancer among Japanese school students, a successful cancer education curriculum, has not been reported. To develop an adequate health education curriculum, knowledge about symptoms, natural history, prevention, and causes of cancer—particularly knowledge about childhood leukemia and prevention of uterine cancer—should be taught from adolescence. As a first step, we investigated the current situation regarding cancer health education.

While public awareness or beliefs regarding cancer have been surveyed in several countries [15–17], most of these surveys were administered to adults, not students. Previous studies have reported on children's knowledge about cancer in the UK [18, 19], with results showing a general familiarity among children regarding names of certain cancers. We applied similar methods to assess the understanding of cancer names among Japanese students. This study also compares rates of cancer recognition among Japanese students with rates reported in studies conducted in other countries.

Here, to clarify the extent of cancer understanding among Japanese students, we conducted a large-scale survey study to assess recognition of cancer names.

Methods

Study design

Our study was a cross-sectional analysis of nationwide self-administered questionnaire survey data. The investigation

was conducted in one class per school, which had been selected by participating schools.

Study setting

We conducted random sampling proportional to the student population of each prefecture and kind of school from "Zenkoku Gakkousouran 2012" using a random number table [20]. The prefecture with the lowest student population was set to 1, and that with the highest student population was set to 18 for elementary schools and 19 for junior high and high schools based on the ratio of the student population. In this way, 213 elementary schools, 222 junior high schools, and 208 high schools were selected from all 47 prefectures in Japan, and questionnaires, the request letter, survey protocol, individual envelopes, and a return envelope were sent to each subject school. We requested that the students be given the questionnaire and an envelope. The students were instructed to seal their responses in the envelope, and the collected written questionnaires in the envelopes were returned by the students' teacher. We asked that the responses be returned all at once and requested the aid of each school in distributing and collecting responses and performing the investigation by class. The target populations of this survey were fifth grade elementary school students (10 or 11 years old), second-year (13 or 14 years old) junior high school students, and second-year (≥16 years old) high school students in Japan. School principals were asked to randomly select one class to participate in the survey. This survey was conducted from January to February 2013, with a return period of approximately 1 month.

Questionnaire

Questionnaire items were adapted from a previous study [18, 19] and reviewed by health education experts, including academic researchers, a medical doctor, an elementary school teacher, a physical education teacher, a school nurse, and a board of education supervisor. The questionnaire listed the names of 15 cancers and asked respondents to choose one answer from three: "Never heard of", "Heard of/Don't understand", and "Heard of/Understand". We described "heard of" as meaning the child had heard of the cancer before, but did not know much about it in detail; "understanding" was when the child had heard of the name and also understood some details about the cancer, such as target organ or cause. We used the same question items, with no explanation of the organs, for all students, from elementary to high school.

Statistical analysis

All statistical analyses were performed using IBM SPSS Statistics Desktop Version 19.0 for Windows (Brush Prairie, WA, USA). After excluding non-responders, we calculated the percentage and 95 % confidence intervals (CIs) for understanding of 15 different cancers. We also performed Fisher's exact tests on the rate of understanding by gender.

Ethics statement

The experimental procedures were approved by the Ethics Committee of the Niigata University of Health and Welfare. A consent procedure was approved by the ethics committees. Students were informed that their answers would remain anonymous and that they were free to refuse participation in the study without penalty. Students were given the questionnaire and an envelope and were allowed to return blank questionnaires, if they chose to do so. We assumed that return of the questionnaires indicated consent for participation in the study by schools. All questionnaires were completed anonymously, and data entry and management was done under the supervision of the investigators.

Results

Response rate of schools and students

The school response rates were 44.1 % ($n = 94$) for elementary schools, 46.4 % ($n = 103$) for junior high schools, and 55.8 % ($n = 116$) for high schools (Table 1). A total of 9,139 questionnaires were collected, and respondents not reporting gender were excluded. In total, we analyzed the responses of 2,213 elementary school students, 2,960 junior high school students, and 3,703 high school students (total 8,876 students).

Table 1 Participation of schools

Prefecture	Elementary	Junior high	High	Prefecture	Elementary	Junior high	High
Hokkaido	3/8	4/9	5/9	Shiga	0/3	2/3	2/2
Aomori	0/2	1/2	1/2	Kyoto	2/4	1/4	0/5
Iwate	3/4	3/4	4/4	Osaka	5/15	3/16	4/15
Miyagi	2/4	2/4	4/4	Hyogo	2/10	4/10	7/9
Akita	0/2	0/2	1/2	Nara	1/2	2/3	0/2
Yamagata	1/2	1/2	0/2	Wakayama	0/2	1/2	0/2
Fukushima	1/4	4/4	4/4	Tottori	1/1	0/1	0/1
Ibaraki	3/5	4/5	3/5	Shimane	0/1	1/1	0/1
Tochigi	3/3	2/3	3/3	Okayama	1/3	0/3	1/3
Gunma	3/4	4/4	3/3	Hiroshima	3/5	3/5	3/5
Saitama	6/12	2/12	8/11	Yamaguchi	1/2	1/2	1/2
Chiba	7/10	8/10	8/9	Tokushima	0/1	1/1	0/1
Tokyo	5/18	9/19	8/19	Kagawa	0/2	2/2	2/2
Kanagawa	7/15	3/15	4/12	Ehime	1/2	2/2	1/2
Niigata	2/4	4/4	2/4	Kochi	0/1	1/1	1/1
Toyama	1/2	0/2	1/2	Fukuoka	1/9	6/9	5/8
Ishikawa	2/2	0/2	0/2	Saga	0/2	0/2	1/2
Fukui	0/1	1/2	1/1	Nagasaki	2/2	1/3	3/3
Yamanashi	1/1	1/2	2/2	Kumamoto	1/3	2/3	2/3
Nagano	4/4	2/4	1/4	Oita	0/2	0/2	1/2
Gifu	1/4	1/4	2/4	Miyazaki	0/2	0/2	1/2
Shizuoka	2/6	2/7	3/6	Kagoshima	3/3	1/3	1/3
Aichi	8/13	5/14	5/12	Okinawa	2/3	2/3	2/3
Mie	2/3	1/3	1/3	Unknown	1/–	3/–	4/–
Total approached (n)					213	222	208
Total participated (n)					94	103	116
Response rate (%)					44.1	46.4	55.8

Participated (n)/approached (n)

Table 2 Understanding of cancer among elementary school students

Kind of cancer	Responses	Boys (n = 1,101)			Girls (n = 1,112)		
		N	%	(95 % CI)	N	%	(95 % CI)
Lung cancer	Never heard	107	10.1	(8.3, 11.9)	72	6.8	(5.3, 8.3)
	Heard/Don't understand	564	53.3	(50.3, 56.3)	616	57.9	(54.9, 60.9)
	Heard/Understand	387	36.6	(33.7, 39.5)	376	35.3	(32.5, 38.2)
Breast cancer	Never heard	182	17.1	(14.9, 19.4)	92	8.5	(6.9, 10.2)
	Heard/Don't understand	595	56.0	(53.0, 59.0)	504	46.8	(43.8, 49.7)
	Heard/Understand	286	26.9	(24.2, 29.6)	482	44.7	(41.7, 47.7)
Leukemia	Never heard	218	20.5	(18.1, 22.9)	164	15.2	(13.1, 17.4)
	Heard/Don't understand	504	47.4	(44.4, 50.4)	540	50.1	(47.1, 53.1)
	Heard/Understand	341	32.1	(29.3, 34.9)	374	34.7	(31.9, 37.5)
Brain tumor	Never heard	393	37.1	(34.2, 40.0)	343	32.0	(29.2, 34.8)
	Heard/Don't understand	392	37.0	(34.1, 39.9)	419	39.0	(36.1, 42.0)
	Heard/Understand	274	25.9	(23.2, 28.5)	311	29.0	(26.3, 31.7)
Esophageal cancer	Never heard	220	20.8	(18.3, 23.2)	181	17.0	(14.7, 19.2)
	Heard/Don't understand	578	54.5	(51.5, 57.5)	615	57.7	(54.7, 60.7)
	Heard/Understand	262	24.7	(22.1, 27.3)	270	25.3	(22.7, 27.9)
Stomach cancer	Never heard	186	17.5	(15.3, 19.8)	167	15.8	(13.6, 18.0)
	Heard/Don't understand	603	56.9	(53.9, 59.9)	646	61.1	(58.1, 64.0)
	Heard/Understand	271	25.6	(22.9, 28.2)	245	23.2	(20.6, 25.7)
Uterine cancer	Never heard	401	38.0	(35.0, 40.9)	240	22.5	(20.0, 25.0)
	Heard/Don't understand	472	44.7	(41.7, 47.7)	525	49.2	(46.2, 52.2)
	Heard/Understand	183	17.3	(15.0, 19.6)	302	28.3	(25.6, 31.0)
Skin cancer	Never heard	353	33.4	(30.5, 36.2)	342	32.2	(29.4, 35.0)
	Heard/Don't understand	487	46.0	(43.0, 49.0)	520	49.0	(46.0, 52.0)
	Heard/Understand	218	20.6	(18.2, 23.0)	200	18.8	(16.5, 21.2)
Liver cancer	Never heard	283	26.7	(24.1, 29.4)	238	22.3	(19.8, 24.8)
	Heard/Don't understand	588	55.6	(52.6, 58.6)	649	60.7	(57.8, 63.6)
	Heard/Understand	187	17.7	(15.4, 20.0)	182	17.0	(14.8, 19.3)
Colon cancer	Never heard	390	37.1	(34.2, 40.1)	361	33.8	(30.9, 36.6)
	Heard/Don't understand	495	47.1	(44.1, 50.2)	568	53.1	(50.1, 56.1)
	Heard/Understand	165	15.7	(13.5, 17.9)	140	13.1	(11.1, 15.1)
Pancreatic cancer	Never heard	580	55.2	(52.2, 58.2)	553	52.1	(49.1, 55.1)
	Heard/Don't understand	375	35.7	(32.8, 38.6)	441	41.5	(38.6, 44.5)
	Heard/Understand	96	9.1	(7.4, 10.9)	68	6.4	(4.9, 7.9)
Ovarian cancer	Never heard	660	63.1	(60.2, 66.0)	624	59.4	(56.5, 62.4)
	Heard/Don't understand	304	29.1	(26.3, 31.8)	344	32.8	(29.9, 35.6)
	Heard/Understand	82	7.8	(6.2, 9.5)	82	7.8	(6.2, 9.4)
Testicular cancer	Never heard	683	65.2	(62.3, 68.1)	726	68.8	(66.0, 71.5)
	Heard/Don't understand	296	28.2	(25.5, 31.0)	275	26.0	(23.4, 28.7)
	Heard/Understand	69	6.6	(5.1, 8.1)	55	5.2	(3.9, 6.5)
Bladder cancer	Never heard	673	64.4	(61.5, 67.3)	712	66.9	(64.0, 69.7)
	Heard/Don't understand	302	28.9	(26.2, 31.6)	291	27.3	(24.6, 30.0)
	Heard/Understand	70	6.7	(5.2, 8.2)	62	5.8	(4.4, 7.2)
Prostate cancer	Never heard	734	69.8	(67.1, 72.6)	826	77.7	(75.2, 80.2)
	Heard/Don't understand	271	25.8	(23.1, 28.4)	209	19.7	(17.3, 22.1)
	Heard/Understand	46	4.4	(3.1, 5.6)	28	2.6	(1.7, 3.6)

CI confidence interval

Table 3 Understanding of cancer among junior high school students

Kind of cancer	Responses	Boys (n = 1,520)			Girls (n = 1,440)		
		N	%	(95 % CI)	N	%	(95 % CI)
Leukemia	Never heard	103	6.9	(5.7, 8.2)	42	3.0	(2.1, 3.8)
	Heard/Don't understand	835	56.3	(53.8, 58.8)	742	52.4	(49.8, 55.0)
	Heard/Understand	545	36.7	(34.3, 39.2)	633	44.7	(42.1, 47.3)
Lung cancer	Never heard	69	4.7	(3.6, 5.7)	46	3.3	(2.3, 4.2)
	Heard/Don't understand	835	56.4	(53.9, 58.9)	807	57.4	(54.8, 59.9)
	Heard/Understand	577	39.0	(36.5, 41.4)	554	39.4	(36.8, 41.9)
Breast cancer	Never heard	76	5.1	(4.0, 6.2)	20	1.4	(0.8, 2.0)
	Heard/Don't understand	1011	67.9	(65.6, 70.3)	680	47.7	(45.1, 50.3)
	Heard/Understand	401	26.9	(24.7, 29.2)	726	50.9	(48.3, 53.5)
Brain tumor	Never heard	218	14.8	(13.0, 16.6)	142	10.0	(8.5, 11.6)
	Heard/Don't understand	763	51.7	(49.1, 54.2)	730	51.6	(49.0, 54.2)
	Heard/Understand	495	33.5	(31.1, 35.9)	544	38.4	(35.9, 41.0)
Uterine cancer	Never heard	305	20.7	(18.6, 22.8)	58	4.1	(3.1, 5.1)
	Heard/Don't understand	912	61.9	(59.4, 64.4)	741	52.5	(49.9, 55.1)
	Heard/Understand	256	17.4	(15.4, 19.3)	613	43.4	(40.8, 46.0)
Esophageal cancer	Never heard	133	9.0	(7.5, 10.4)	83	5.9	(4.6, 7.1)
	Heard/Don't understand	950	64.1	(61.7, 66.6)	928	65.4	(63.0, 67. 9)
	Heard/Understand	398	26.9	(24.6, 29.1)	407	28.7	(26.3, 31.1)
Stomach cancer	Never heard	156	10.5	(9.0, 12.1)	116	8.2	(6.7, 9.6)
	Heard/Don't understand	901	60.9	(58.4, 63.4)	930	65.4	(63.0, 67. 9)
	Heard/Understand	423	28.6	(26.3, 30.9)	375	26.4	(24.1, 28.7)
Skin cancer	Never heard	244	16.5	(14.6, 18.4)	205	14.5	(12.7, 16.4)
	Heard/Don't understand	850	57.6	(55.1, 60.1)	836	59.2	(56.6, 61.8)
	Heard/Understand	381	25.8	(23.6, 28.1)	371	26.3	(24.0, 28.6)
Liver cancer	Never heard	212	14.4	(12.6, 16.2)	200	14.2	(12.4, 16.1)
	Heard/Don't understand	957	65.1	(62.7, 67.6)	932	66.4	(63.9, 68.9)
	Heard/Understand	300	20.4	(18.4, 22.5)	272	19.4	(17.3, 21.4)
Colon cancer	Never heard	397	27.1	(24.9, 29.4)	367	26.3	(24.0, 28.6)
	Heard/Don't understand	848	58.0	(55.4, 60.5)	819	58.8	(56.2, 61.3)
	Heard/Understand	218	14.9	(13.1, 16.7)	208	14.9	(13.1, 16.8)
Pancreatic cancer	Never heard	455	31.2	(28.8, 33.5)	409	29.2	(26.8, 31.6)
	Heard/Don't understand	843	57.7	(55.2, 60.3)	850	60.7	(58.2, 63.3)
	Heard/Understand	162	11.1	(9.5, 12.7)	141	10.1	(8.5, 11.6)
Prostate cancer	Never heard	614	42.1	(39.6, 44.6)	675	48.4	(45.8, 51.0)
	Heard/Don't understand	681	46.7	(44.1, 49.2)	593	42.5	(39.9, 45.1)
	Heard/Understand	164	11.2	(9.6, 12.9)	127	9.1	(7.6, 10.6)
Ovarian cancer	Never heard	752	52.1	(49.5, 54.7)	717	51.4	(48.8, 54.0)
	Heard/Don't understand	567	39.3	(36.7, 41.8)	529	37.9	(35.4, 40.5)
	Heard/Understand	125	8.7	(7.2, 10.1)	149	10.7	(9.1, 12.3)
Bladder cancer	Never heard	770	53.2	(50.6, 55.7)	756	54.3	(51.7, 57.0)
	Heard/Don't understand	548	37.8	(35.3, 40.3)	523	37.6	(35.1, 40.1)
	Heard/Understand	130	9.0	(7.5, 10.5)	112	8.1	(6.6, 9.5)
Testicular cancer	Never heard	767	52.8	(50.2, 55.3)	821	58.7	(56.1, 61.3)
	Heard/Don't understand	566	38.9	(36.4, 41.4)	476	34.0	(31.5, 36.5)
	Heard/Understand	121	8.3	(6.9, 9.7)	102	7.3	(5.9, 8.7)

CI confidence interval

Table 4 Understanding of cancer among high school students

Kind of cancer	Responses	Boys (*n* = 1,546)			Girls (*n* = 2,157)		
		N	%	(95 % CI)	N	%	(95 % CI)
Breast cancer	Never heard	38	2.5	(1.7, 3.3)	24	1.1	(0.7, 1.6)
	Heard/Don't understand	876	57.4	(54.9, 59.9)	829	38.8	(36.8, 40.9)
	Heard/Understand	612	40.1	(37.6, 42.6)	1282	60.0	(58.0, 62.1)
Leukemia	Never heard	50	3.3	(2.4, 4.2)	40	1.9	(1.3, 2.5)
	Heard/Don't understand	812	53.2	(50.7, 55.7)	908	42.6	(40.5, 44.7)
	Heard/Understand	664	43.5	(41.0, 46.0)	1184	55.5	(53.4, 57.6)
Lung cancer	Never heard	44	2.9	(2.1, 3.7)	33	1.6	(1.0, 2.1)
	Heard/Don't understand	747	49.2	(46.7, 51.7)	1064	50.2	(48.0, 52.3)
	Heard/Understand	728	47.9	(45.4, 50.4)	1024	48.3	(46.2, 50.4)
Uterine cancer	Never heard	124	8.2	(6.8, 9.5)	59	2.8	(2.1, 3.5)
	Heard/Don't understand	986	64.9	(62.5, 67.3)	972	45.6	(43.5, 47.7)
	Heard/Understand	409	26.9	(24.7, 29.2)	1100	51.6	(49.5, 53.7)
Brain tumor	Never heard	97	6.4	(5.1, 7.6)	96	4.5	(3.6, 5.4)
	Heard/Don't understand	880	57.8	(55.3, 60.3)	1154	54.1	(52.0, 56.2)
	Heard/Understand	545	35.8	(33.4, 38.2)	883	41.4	(39.3, 43.5)
Skin cancer	Never heard	93	6.1	(4.9, 7.3)	86	4.0	(3.2, 4.9)
	Heard/Don't understand	899	59.1	(56.6, 61.5)	1218	57.1	(55.0, 59.2)
	Heard/Understand	530	34.8	(32.4, 37.2)	828	38.8	(36.8, 40.9)
Stomach cancer	Never heard	66	4.3	(3.3, 5.4)	68	3.2	(2.4, 3.9)
	Heard/Don't understand	910	59.8	(57.3, 62.2)	1264	59.4	(57.3, 61.5)
	Heard/Understand	547	35.9	(33.5, 38.3)	796	37.4	(35.4, 39.5)
Esophageal cancer	Never heard	76	5.0	(3.9, 6.1)	59	2.8	(2.1, 3.5)
	Heard/Don't understand	940	61.6	(59.2, 64.0)	1303	61.0	(59.0, 63.1)
	Heard/Understand	510	33.4	(31.1, 35.8)	773	36.2	(34.2, 38.2)
Liver cancer	Never heard	102	6.7	(5.5, 8.0)	115	5.4	(4.4, 6.4)
	Heard/Don't understand	982	64.8	(62.4, 67.2)	1450	68.1	(66.1, 70.1)
	Heard/Understand	432	28.5	(26.2, 30.8)	565	26.5	(24.7, 28.4)
Colon cancer	Never heard	222	14.7	(12.9, 16.5)	277	13.1	(11.7, 14.6)
	Heard/Don't understand	929	61.4	(58.9, 63.9)	1345	63.7	(61.7, 65.8)
	Heard/Understand	362	23.9	(21.8, 26.1)	488	23.1	(21.3, 24.9)
Prostate cancer	Never heard	336	22.2	(20.1, 24.3)	620	29.2	(27.3, 31.1)
	Heard/Don't understand	909	60.0	(57.6, 62.5)	1173	55.3	(53.1, 57.4)
	Heard/Understand	269	17.8	(15.8, 19.7)	330	15.5	(14.0, 17.1)
Pancreatic cancer	Never heard	264	17.5	(15.6, 19.4)	305	14.4	(12.9, 15.9)
	Heard/Don't understand	1010	67.0	(64.6, 69.3)	1495	70.5	(68.5, 72.4)
	Heard/Understand	234	15.5	(13.7, 17.3)	322	15.2	(13.6, 16.7)
Ovarian cancer	Never heard	576	38.2	(35.7, 40.6)	757	35.9	(33.9, 38.0)
	Heard/Don't understand	730	48.4	(45.9, 50.9)	1010	47.9	(45.8, 50.0)
	Heard/Understand	202	13.4	(11.7, 15.1)	341	16.2	(14.6, 17.7)
Testicular cancer	Never heard	575	38.0	(35.6, 40.5)	871	41.2	(39.1, 43.3)
	Heard/Don't understand	725	47.9	(45.4, 50.5)	1018	48.1	(46.0, 50.3)
	Heard/Understand	212	14.0	(12.3, 15.8)	226	10.7	(9.4, 12.0)
Bladder cancer	Never heard	555	36.9	(34.5, 39.3)	905	42.8	(40.7, 44.9)
	Heard/Don't understand	755	50.2	(47.7, 52.7)	989	46.8	(44.6, 48.9)
	Heard/Understand	194	12.9	(11.2, 14.6)	221	10.4	(9.1, 11.8)

CI confidence interval

Elementary school students

Among male elementary school students ($n = 1,101$), high rates of understanding were observed for lung cancer (36.6 %) and leukemia (32.1 %) (Table 2). Low rates of understanding were observed for prostate cancer (4.4 %), testicular cancer (6.6 %), bladder cancer (6.7 %), ovarian cancer (7.8 %), and pancreatic cancer (9.1 %).
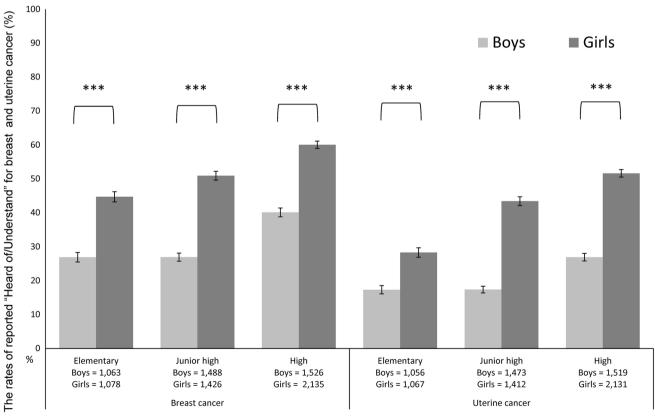
Among female elementary school students ($n = 1,112$), high rates of understanding were observed for breast cancer (44.7 %), lung cancer (35.3 %) and leukemia (34.7 %). Low rates of understanding were observed for prostate cancer (2.6 %), testicular cancer (5.2 %), bladder cancer (5.8 %), pancreatic cancer (6.4 %), and ovarian cancer (7.8 %).

Junior high school students

Among male junior high school students ($n = 1,520$), high rates of understanding were observed for lung cancer (39.0 %), leukemia (36.7 %), and brain tumor (33.5 %) (Table 3). Low rates of understanding were observed for

testicular cancer (8.3 %), ovarian cancer (8.7 %), and bladder cancer (9.0 %).

Among female junior high school students ($n = 1,440$), high rates understanding were observed for breast cancer (50.9 %), leukemia (44.7 %), uterine cancer (43.4 %), lung cancer (39.4 %), and brain tumors (38.4 %). Low rates of understanding were observed for testicular cancer (7.3 %), bladder cancer (8.1 %), and prostate cancer (9.1 %).

High school students

Among male high school students ($n = 1,546$), high rates of understanding were observed for lung cancer (47.9 %), leukemia (43.5 %), breast cancer (40.1 %), stomach cancer (35.9 %), brain tumors (35.8 %), skin cancer (34.8 %), and esophageal cancer (33.4 %) (Table 4). While low rates of understanding (<10 %) were not observed for any cancer, bladder cancer (12.9 %) had the lowest rate of understanding.

Among female high school students ($n = 2,157$), high rates of understanding were observed for breast cancer (60.0 %), leukemia (55.5 %), uterine cancer (51.6 %), lung

Fig. 1 Response rates of "Heard of/Understand" about breast cancer and uterine cancer. ***$p < 0.001$ by Fisher's exact test. *Error bar* standard error

cancer (48.3 %), brain tumors (41.4 %), skin cancer (38.8 %), stomach cancer (37.4 %), and esophageal cancer (36.2 %). Rate of understanding was lowest for bladder cancer (10.4 %).

Gender differences in understanding

Girls were more likely to report "Heard of/Understand" for breast cancer and uterine cancer than boys (Fig. 1). The rates of understanding for breast cancer were 26.9 % in males and 44.7 % in females for elementary school students ($p < 0.001$); 29.6 % in males and 50.9 % in females for junior high school students ($p < 0.001$); and 40.1 % in males and 60.0 % in females for high school students ($p < 0.001$). Similarly, the recognition rates for uterine cancer were 17.3 % in males and 28.3 % in females for elementary school students ($p < 0.001$); 17.4 % in males and 43.4 % in females for junior high school students ($p < 0.001$); and 26.9 % in males and 51.6 % in females for high school students ($p < 0.001$).

Discussion

In the present study, we attempted to clarify the current status of cancer understanding among Japanese school students by means of a self-administered questionnaire. This nationwide survey included a large sample of children ($n = 8,876$) from throughout Japan. We found that girls were more knowledgeable than boys regarding breast and uterine cancer. Awareness of lung cancer and leukemia was high from elementary school through high school. Cancer understanding was greatest among high school students and lowest among elementary school students.

In a previous UK study of children aged 15–16 years, the cancers for which respondents responded with "Heard of/Know about" were lung cancer (67.7 %), leukemia (56.1 %), and breast cancer (54.5 %) [18]. High school students in the present study were aged approximately 16–17 years. Despite the similarity in age range, recognition rates of lung cancer, leukemia, and breast cancer among UK students were higher than among Japanese students. However, recognition of uterine cancer was higher among Japanese high school students than UK ones (41.3 vs. 22.8 %). This discrepancy may be explained by the fact that a national government project targeted at females aged 13–16 years and recommending vaccination against HPV were conducted in Japan from 2010 to 2013.

Another study reported that awareness of childhood cancer among adolescents in Britain aged 11–17 years was most common for leukemia (20.1 %) [21]. In addition, breast cancer was the most commonly recognized female cancer for three-quarters of adolescents (76.6 %). Although

the methods of investigation were slightly different from those used in the present study, similar results of high recognition of leukemia and breast cancer were obtained.

In a recent study among Scottish children aged 8–11 years, the type of cancer most frequently reported by both gender groups of primary school grades 4 and 6 was breast cancer, followed by lung cancer [19]. Lung cancer is typically discussed when learning about smoking prevention in Japanese elementary school health classes. Similarly, in Japan, many movies and TV dramas depict characters suffering from leukemia, some of which have proven quite popular. In addition, infant leukemia is often shown in the media. Breast cancer is also the leading cancer incidence site among Japanese females, therefore a student is more likely to know someone with breast cancer than with another type of cancer. Additionally, the "pink ribbon" campaign for breast cancer prevention is promoted in Japan, thereby increasing notoriety of the cancer among the populace.

More than 90 % of Japanese high school students answered "heard of" for uterine cancer in the present study. Previous reports have proven similar to our own, with more than 90 % of Swedish young adults and parents having heard of cervical cancer and 70 % of young men being aware of the disease [22]. Another study found that 85 % of respondents to a survey conducted among female Malaysian university students were aware of cervical cancer [23]. Based on these results, the next step is to clarify the extent of understanding and promote knowledge of viral causes of uterine cancer and methods of prevention.

The total incidence of cancer in Japan for 2007 was estimated to be 704,090 [4]. Among site-specific cancers in Japan in 2007, the top five most incident cancers among males were stomach, lung, colon/rectum, prostate, and liver. In females, the breast was the leading cancer site, followed by the colon/rectum, stomach, lung, and liver. According to a recent report on cancer mortality in Japan, the site-specific cancers with the highest mortality among men were lung, stomach, colorectal, liver, and prostate cancer [5]. Although the prostate was one of the most common sites for cancer among males, few respondents knew about or had even heard of prostate cancer in our study. In contrast, breast cancer was relatively well known by respondents of both genders. Conversely, while the actual incidence of leukemia was not markedly high, the cancer was still well known among students.

Knowledge of the etiology and natural history of cancer is important for effectively implementing a preventive education curriculum, and further research in Japan similar to studies conducted in other countries is warranted [24– 26]. Additionally, given that the screening rate for breast cancer in Japan is less than 25 % (lower than other countries) despite the markedly high rate of recognition among

high school students (90 %) [3], an effective educational program for improving the screening rate must be considered. Further, since prevention strategies are known for a number of cancers in Japan [9], education addressing preventable risk factors should be considered.

In the course of study of health and physical education in high school level [11], contents about cancer are described as follows: "Students understand the necessity of healthy lifestyle, including the lifestyle of well balanced in terms of diet, exercise, rest and sleep, to prevent lifestyle-related disease and to maintain health. And also understand that the lifestyles are deeply related to the diseases such as malignant neoplasm, coronary heart disease, dyslipidemia, and periodontal disease." These are related contents on cancer, but do not directly address the knowledge of cancer. Fewer than 50 % of students of all school levels were familiar with most cancers. It suggests that cancer education is deficient. The framework of cancer education should be examined to improve students' fundamental understandings.

At present, educational materials regarding cancer in health textbooks are on sections of lifestyle-related diseases prevention, harm of smoking, and community health. Knowledge of lung cancer among elementary and junior high school student is low. It means the need to expand educational curricula related to this disease. Moreover, the difference between boys and girls in knowledge of uterine and breast cancers was relatively large, suggesting that cancer education to increase common recognition is necessary.

As an institutional problem, cancer knowledge is generally not included in the content that students are taught directly or on which they are evaluated. Further research is needed to determine the optimal target age, the appropriate teaching materials, and the methods of evaluation for cancer education. The practical curriculum study is also needed to assess that what contents of cancer education should be included in health and physical education or special activities or integrated studies.

Several limitations to the present study warrant mention. First, given that we analyzed only one grade from each school level, we may have arrived at different conclusions had we examined trends in other grades. Second, we showed the number of participating schools and responses by prefecture; however, students' response rates and demographic differences were unknown. Finally, the response of "Heard of/Understand" regarding any given cancer failed to capture the extent of students' understanding. For example, while the distinction between "heard of" and "understand" for leukemia was probably clear, whether students understanding lung cancer as "a cancer that occurs in the lungs" would answer "Heard of/

Don't understand" or "Heard of/Understand" was uncertain.

In conclusion, findings from our nationwide survey indicate that the most commonly recognized cancers differed by grade, suggesting that targeted educational efforts are needed at various grade levels. Further, marked differences in cancer recognition by gender suggest the need for gender-specific cancer education. More than 50 % of students at any school level were not familiar with most cancers. It suggests that cancer education is deficient.

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