

RESEARCH ARTICLE

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Awareness of Cancer Among Japanese Junior and Senior High School Students and Relevant Factors

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Abstract

Objective: The purpose of this study was to clarify cancer awareness among Japanese youths, identify relevant factors, and gain insight into effective educational interventions to prevent cancer and promote early detection in youths. **Methods:** We conducted an anonymous, fact-finding questionnaire survey via the Internet, covering three modules of the Cancer Awareness Measure (cancer risk factors, cancer warning signs, and barriers to help-seeking), along with individual and environmental factors. Descriptive statistics were generated, and chi-squared tests and logistic regression analyses were performed to clarify the associations between cancer awareness and individual and environmental factors. **Results:** In total, 612 junior and senior high school students were enrolled. The median (interquartile range) total score was 7 (4–10) for cancer risk factors, 0 (0–5) for cancer warning signs, and 4 (2–7) for barriers to help-seeking. Less than half of the students correctly recognized risk factors specific to cancer, such as human papillomavirus, hepatitis B virus, and hepatitis C virus infections. As for barriers to help-seeking, many students pointed to emotional barriers such as fear (62.9%). Other major barriers to help-seeking were female gender (odds ratio [OR]=2.80, 95% confidence interval [CI]: 1.73, 4.53, $p < 0.001$), conversations with parents about cancer (OR=2.28, 95% CI: 1.28, 4.08, $p = 0.005$), and awareness of cancer warning signs (OR=1.04, 95% CI: 1.04, 1.81, $p = 0.003$). **Conclusion:** Japanese adolescents do not have sufficient awareness of cancer. In cancer education, it is necessary to clearly highlight cancer-specific risk factors and warning signs in an easy-to-understand manner, explain the importance of early detection, and consider the content of cancer-related conversations between children and parents.

Keywords: Cancer- Risk Factors- Signs and Symptoms- Help-Seeking Behavior- Health Knowledge- Adolescents

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Introduction

Cancer is a leading cause of death worldwide, and cancer morbidity and mortality is rapidly increasing globally [1], including in Japan [2]. Causes of cancer in Japan include lifestyle habits (e.g., smoking/passive smoking and alcohol consumption) and hepatitis B virus/hepatitis C virus (HBV/HCV) and human papillomavirus (HPV) infections, which are believed to account for 43.4% of cancer cases among men and 25.3% among women [3]. Therefore, approximately half of cancers in men and one-third in women are preventable. In addition, the HPV vaccination rate is 0.3%, which is low from a global perspective [4], and the cancer screening rate is only 30%–40% [5]. Therefore, there is an urgent need to promote cancer prevention and early detection in Japan.

Adolescence is an important period for educational interventions for cancer prevention, during which harmful lifestyle behaviors associated with cancer development, including alcohol consumption and tobacco use, are initiated or established [6]. Therefore, learning about cancer risk factors and acquiring healthy behaviors during adolescence may improve cancer-preventing behaviors in adulthood [7]. In addition, time lag until cancer diagnosis is an issue for the AYA generation [8]. Because lack of awareness of cancer warning signs and delay in seeking medical care are associated with delayed cancer diagnosis [9], it is important to understand cancer warning signs in adolescence and the actions necessary for early detection.

Knowledge of adolescents regarding cancer is low, and there is a gap between knowledge and health behavior in various countries [10–12]. In addition, gender [13–15]

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anxiety [14], and acquaintances who have experienced cancer [16] are factors related to knowledge of cancer among adolescents and barriers to help-seeking. Significant improvements in short-term knowledge, attitudes, self-efficacy, and behavioral intentions were observed in adolescents after cancer education interventions [17, 18], related to gender and acquaintances with cancer experience [16]. Therefore, in interventions, we should focus on adolescents' awareness of cancer and related factors.

Awareness of cancer names [19], causes and sources of information [20], and intentions to undergo screening [21] have been reported among Japanese adolescents. However, awareness of factors related to cancer prevention and early detection (e.g., risk factors, warning signs, and barriers to help-seeking) have not been clarified. The Japanese Basic Act on Cancer Control requires implementation and enhancement of cancer education for junior and senior high school students. However, there are difficulties in securing time to study cancer, inadequate efforts toward ensuring comprehensive understanding [22], and difficulty in coordinating with external lecturers (e.g., medical personnel) [23]. Therefore, effective cancer education interventions methods for adolescents are urgently needed.

This study aimed to clarify awareness of cancer among Japanese adolescents, and related factors, and to obtain insight into effective educational intervention methods for cancer prevention and early detection among adolescents.

Materials and Methods

Study design

This fact-finding study used an anonymous Internet questionnaire survey.

Setting and sample

The participants were junior and senior high school students (aged 12–18 years) from all over Japan. Consent was obtained through their parents, who were registered with an online survey company. Assuming a response rate of 0.5, sampling error of 5%, and confidence level of 95% ($\lambda = 1.96$), the required sample was 400 people according to the formula $n = \lambda^2 p(1 - p)/d^2$. Sampling was based on the male/female ratio of junior and senior high school students and the distribution of students by prefecture [24], to avoid gender/regional bias. Parents of junior/senior high school students were identified through the online survey company, and those meeting the selection criteria were confirmed via the Internet. The survey was conducted with the consent of both the children and parents in March 2022.

Survey instrument

Cancer awareness

Items concerning cancer awareness were taken from the Cancer Awareness Measure (CAM), developed by Cancer Research UK to survey cancer awareness among the general public and children [25]. CAM consists of 47 items and nine modules. To clarify awareness of cancer prevention and early detection, 11 cancer risk factors in Module 6, 9 cancer warning signs in Module

2, and 10 barriers to help-seeking (4 emotional barriers, 3 practical barriers, 3 service barriers) in Module 4 were translated into Japanese. However, because cancer risk factors differ slightly between Japan and other countries, the Prevention Research Group of the National Cancer Center risk factors [26] were added. A 5-point Likert scale (“strongly disagree” to “strongly agree”) was used for items concerning risk factor awareness. The response options for awareness of warning signs items were “yes,” “no,” and “do not know,” and those for barriers to help-seeking items were “frequently,” “sometimes,” “never,” and “do not know.” CAM has been confirmed to be reliable (Cronbach's $\alpha = 0.77$) [27].

Relevant factors

Referring to previous literature, individual factors were grade, gender, presence/absence of cancer experience (personal, family members, relatives, friends/acquaintances), and presence/absence of conversations about cancer with parents. Environmental factors were junior or senior high school, type of school, and presence/absence of cancer education at school.

Data analysis

Descriptive statistics were generated for the items on cancer risk factors, cancer warning signs, and barriers to medical institution visits. The responses of “strongly agree” and “agree” to cancer risk factor items, “yes” to cancer warning sign items, and “frequently” and “sometimes” to barriers to help-seeking items scored 1 point. The total score was calculated by tabulating the scores for these items. Chi-squared test clarified the associations of individual and environmental factors with the individual item scores. To explore factors related to perceptions of barriers to help-seeking; whether students were in junior or senior high school; school type; gender; presence/absence of cancer experience (personal, family, or relatives), cancer education, or conversations with parents regarding cancer, total scores for items on cancer risk factors and cancer warning signs were the independent variables in a logistic regression analysis (“variable increase” method [likelihood ratio]). Concerning perceived barriers to help-seeking, an item score of 0–4 was classified as “low barrier”, and 5–10 as “high barrier”. Independent/dummy variables were grouped as follows. Type of school was divided into “national”/“public” (1 point) and “private” (0 points). Presence/absence of cancer experience and cancer education at school were divided into “yes” (1 point) and “no”/“do not know” (0 points); those answering “prefer not to answer” were excluded. Presence/absence of conversations regarding cancer with parents was divided into “frequently”/“sometimes” (1 point) and “never” (0 points); those who chose “prefer not to answer” were excluded.

For the analysis, SPSS ver. 28.0 (IBM Corp., Armonk, NY, USA) was used; significance was set at 5%.

Ethical considerations

Respondents were informed in writing of the study purpose, and that participation was voluntary and refusal would not result in any disadvantages, their identities of

would be protected, personal information would not be collected from the survey company, and survey data would only be used for research.

Results

Sample

Table 1 shows the characteristics of the participants. In total, there were 612 respondents, 102 in each school year (first to third year of junior high school and first to third year of senior high school). The male-to-female ratio was 50%. Concerning cancer experience, 78 respondents (12.7%) had experienced it themselves, 249 (40.7%) stated that a close family member (father, mother, or grandparents) had experienced it, 103 (16.8%) stated that other relatives (excluding father, mother, and grandparents) had experienced it, and 20 (3.3%) stated their friends or acquaintances had experienced it. Meanwhile, 238 respondents (38.9%) stated they had received cancer education at school, and 115 (18.8%) that they “often/sometimes” had conversations with their parents about cancer.

Cancer awareness

The mean (standard deviation)/median (interquartile range) total score was 6.72 (3.38)/7 (4–10) for cancer risk factors, 2.59 (3.48)/0 (0–5) for cancer warning signs, and 4.27 (3.07)/4 (2–7) for barriers to help-seeking (emotional barrier, 2.11 [1.49]/2 [0–4]; ; practical barrier, 1.14 [1.04]/1 [0–3]; service barrier, 1.03 (1.03)/1 [0–3]).

Cancer risk factors

The most widely recognized cancer risk factors were smoking (91.8%) and passive smoking (91.2%). Risk factors less than half of the students recognized included lack of moderate physical activity (44.8%), HPV/HBV/HCV infection (43.8%), and excessive intake of red/processed meat (39.5%) (Table 2).

Cancer warning signs

The most widely recognized cancer warning signs were unexplained bleeding (34.2%), unexplained lump (33.0%), and unexplained, incurable pain (33.0%). Meanwhile, 20%–30% of the students correctly recognized the other warning signs. Students answering “no (unlikely)/do not know” to all cancer warning sign items accounted for approximately half of the respondents (55.8%; 338 people) (Table 3).

Barriers to help-seeking

The most widely recognized barriers to help-seeking were emotional barriers such as fear (62.9%), lack of confidence in telling doctors about symptoms (55.2%), shame (55.1%), and worry that the doctor might find something (37.6%) (Table 4).

Relevant factors for cancer awareness

Cancer risk factors and individual/environmental factors

Regarding the relationships between cancer risk factor item scores and individual and environmental factors, some of the χ^2 test results were significant (Table 5).

Table 1. Characteristics of the Students

	n	(%)
Sex		
Male	306	-50
Female	306	-50
School year level (age)		
First year of middle school (11–12)	102	-16.7
Second year of middle school (12–13)	102	-16.7
Third year of middle school (13–14)	102	-16.7
First year of high school (14–15)	102	-16.7
Second year of high school (15–16)	102	-16.7
Third year of high school (17–18)	102	-16.7
Institution		
National	15	-2.5
Public	447	-73
Private	129	-21.1
Experience with cancer		
Self	78	-12.7
Family	249	-40.7
Relatives	103	-16.8
Friend/acquaintance	20	-3.3
Cancer education at school		
Yes	238	-38.9
No	244	-39.9
Unknown	130	-21.2
Conversation with parents regarding cancer		
Yes (often/sometimes)	115	-18.8
No (rarely/never)	483	-78.9
Do not want to answer	14	-2.3

Table 2. Proportion of Students who Correctly Recognized Risk Factors for Cancer

	n	(%)
Smoking any cigarettes at all	562	91.8
Exposure to another person's cigarette smoke	558	91.2
Having a close relative with cancer	411	67.2
Drinking approximately > 2 cans/day of alcohol	406	66.3
Being overweight (BMI $\geq$ 25 kg/m ²)	383	62.6
Consuming $\geq$ 8 g/day of salt	364	59.5
Eating < 400 g of fruits and vegetables a day	337	55.1
Aged > 70 years	310	50.7
Doing < 60 min of moderate physical activity a day	274	44.8
Infection with HPV or HBV/HCV	268	43.8
Eating red or processed meat once a day or more	242	39.5

BMI, body mass index; HBV, hepatitis B virus; HCV, hepatitis C virus; HPV, human papillomavirus.

Among students who had conversations about cancer with their parents, the most widely recognized risk factors were excessive alcohol intake ($\chi^2 = 5.293$, $p = 0.021$), lack of fruits and vegetables ($\chi^2 = 4.835$, $p = 0.028$), excessive

Table 3. Proportion of Students who Correctly Recognized Cancer Warning Signs

	n	(%)
Unexplained bleeding	209	34.2
A sore that does not heal	202	33
Unexplained lump or swelling	202	33
Unexplained weight loss	194	31.7
Persistent unexplained pain	185	30.2
Change in the appearance of a mole	150	24.5
Persistent difficulty swallowing food	148	24.2
Persistent cough or hoarseness	148	24.2
Persistent change in bowel or bladder habits	148	24.2

Table 4. Proportion of Students Recognizing Barriers to Help-Seeking

	n	(%)
I would be too scared	385	62.9
I would not feel confident talking about my symptom(s) with the doctor	338	55.2
I would be too embarrassed	337	55.1
My doctor would be difficult to talk to	323	52.8
I would be too busy to make time to go to the doctor	288	47.1
I have too many other things to worry about	256	41.8
I would be worried about what the doctor might find	230	37.6
It would be difficult to make an appointment with the doctor	189	30.9
It would be difficult for me to arrange transportation to the hospital	152	24.8
I would be worried about wasting the doctor's time	118	19.3

intake of red meat and processed meat ($\chi^2 = 8.605$, $p = 0.003$), obesity ($\chi^2 = 4.170$, $p = 0.041$), being an older adult ($\chi^2 = 4.078$, $p = 0.043$), having a close relative with cancer ($\chi^2 = 6.085$, $p = 0.014$), HPV/HBV/HCV infection ($\chi^2 = 12.365$, $p < 0.001$), and lack of moderate physical activity ($\chi^2 = 4.06$, $p = 0.044$). Among the students who had received cancer education at school, the most widely recognized risk factors were passive smoking ($\chi^2 = 12.536$, $p < 0.001$), excessive alcohol intake ($\chi^2 = 6.871$, $p = 0.009$), obesity ($\chi^2 = 5.931$, $p = 0.015$), and lack of moderate physical activity ($\chi^2 = 9.006$, $p = 0.003$).

Cancer warning signs and individual and environmental factors

Regarding the relationships between cancer warning sign item scores and individual/environmental factors, significant chi-squared results are shown in Table 6. The most widely recognized cancer warning signs overall were unexplained lumps or swelling ($\chi^2 = 4.995$, $p = 0.025$), changes in defecation/urination habits ($\chi^2 = 5.133$, $p = 0.023$), and difficulty swallowing food ($\chi^2 = 4.313$, $p = 0.0038$). The most widely recognized cancer warning signs among students who had personal experience of

Table 5. Relationships between Risk Factors for Cancer and Individual/Environmental Risk Factors

Proportion of correctly recognized risk factors	Smoking any cigarettes at all	Exposure to another person's cigarette smoke	Drinking approximately > 2 cans/day (350 mL) of alcohol	Eating < 400 g (~ 6 small bowls) of fruits and vegetables a day	Eating red or processed meat (e.g., ham, sausages, bacon) once a day or more	Being overweight (BMI ≥ 25 kg/m ²)	Consuming ≥ 8 g/day of salt	Aged > 70 years	Having a close relative with cancer	Infected with HPV or HBV/HCV	Doing < 60 min of moderate physical activity a day
% (n)	Significance	% (n)	Significance	Yes	Significance	% (n)	Significance	% (n)	Significance	% (n)	Significance
	χ^2		χ^2		χ^2		χ^2		χ^2		χ^2
Conversation with parents regarding cancer											
Yes	95.7 (110)	0.134 (110)	95.7 (110)	0.084 (87)	0.021 (74)	64.3 (74)	0.028 (59)	51.3 (59)	0.003 (82)	71.3 (82)	0.041 (78)
No	91.5 (442)	2.243 (438)	90.7 (438)	2.993 (311)	5.293 (256)	53.0 (256)	4.835 (176)	36.4 (176)	8.605 (295)	61.1 (295)	4.17 (280)
Cancer education											
Yes	95.0 (227)	0.06 (231)	96.7 (231)	$< .001$ (177)	0.009 (142)	59.4 (142)	0.299 (99)	41.4 (99)	0.48 (167)	69.9 (167)	0.015 (154)
No	90.5 (220)	3.534 (214)	88.1 (214)	12.536 (153)	6.871 (133)	54.7 (133)	1.078 (93)	38.3 (93)	0.499 (144)	59.3 (144)	5.931 (137)

χ^2 , chi-squared statistic; BMI, body mass index; HBV, hepatitis B virus; HCV, hepatitis C virus; HPV, human papillomavirus.

Table 6. Relationships between Cancer Warning Signs and Individual/Environmental Factors

Proportion of correctly recognized risk factors	Unexplained lump or swelling	Persistent unexplained pain	Unexplained bleeding	Persistent cough or hoarseness	Persistent change in bowel or bladder habits	Proportion of correctly recognized risk factors	Persistent difficulty swallowing food	Change in the appearance of a mole	A sore that does not heal	Unexplained weight loss
% (n)	Significance	% (n)	Significance	% (n)	Significance	% (n)	Significance	% (n)	Significance	% (n)
χ^2	χ^2	χ^2	χ^2	χ^2	χ^2	χ^2	χ^2	χ^2	χ^2	χ^2
Student type										
Middle school student	28.8 (88)	0.025	27.1 (83)	0.094	31.4 (96)	0.147	21.2 (65)	0.089	20.3 (62)	0.023
High school student	37.3 (114)	4.995	33.3 (102)	2.797	36.9 (113)	2.1	21.1 (83)	2.887	28.1 (86)	5.133
Experience with cancer (self)										
Yes	25.6 (20)	0.109	26.9 (21)	0.434	29.5 (23)	0.275	17.9 (14)	0.133	19.2 (15)	0.222
No	34.8 (178)	2.563	31.3 (160)	0.612	35.8 (183)	1.19	25.8 (132)	2.256	25.6 (131)	1.489
Conversation with parents regarding cancer										
Yes	40.0 (46)	0.089	38.3 (44)	0.042	43.5 (50)	0.029	25.2 (29)	0.86	29.6 (34)	0.167
No	31.7 (153)	2.898	28.6 (138)	4.119	32.7 (158)	4.746	24.4 (118)	0.031	23.4 (113)	1.907
Cancer education										
Yes	39.7 (95)	0.015	35.6 (85)	0.074	40.6 (97)	0.02	26.8 (64)	0.752	29.7 (71)	0.061
No	29.2 (71)	5.918	28.0 (68)	3.196	30.5 (74)	5.405	25.5 (62)	0.1	22.2 (54)	3.514
Middle/high school										
Middle school student	20.6 (63)	0.038	21.2 (65)	0.06	32.0 (98)	0.606	29.4 (90)	0.224		
High school student	27.8 (85)	4.313	27.8 (85)	3.532	34.0 (104)	0.266	34.0 (104)	1.479		
Experience with cancer (self)										
Yes	21.8 (17)	0.511	19.2 (15)	0.21	23.1 (18)	0.032	26.9 (21)	0.279		
No	25.2 (129)	0.432	25.8 (132)	1.574	35.4 (181)	4.609	33.1 (169)	1.171		
Conversation with parents regarding cancer										
Yes	28.7 (33)	0.234	30.4 (35)	0.116	43.5 (50)	0.011	34.8 (40)	0.494		
No	23.4 (113)	1.414	23.4 (113)	2.471	31.1 (150)	6.439	31.5 (152)	0.468		
Cancer education										
Yes	27.6 (66)	0.347	33.1 (79)	<.001	38.1 (91)	0.237	40.2 (96)	0.005		
No	23.9 (58)	0.885	19.3 (47)	11.735	32.9 (80)	1.398	28.0 (68)	7.968		

χ^2 , chi-squared statistic

Table 7. Relationships between Barriers to Visiting a Medical Institution and Individual/Environmental Factors

Proportion recognizing barriers	Emotional barriers						Practical barriers			Service barriers		
	I would be too embarrassed	I would be too scared	I would be worried about what the doctor might find	I would not feel confident talking about my symptom(s) with the doctor	I would be too busy to make time to go to the doctor	I have too many other things to worry about	It would be difficult for me to arrange transportation to the hospital	It would be difficult to make an appointment with the doctor	I would be worried about wasting the doctor's time	My doctor would be difficult to talk to		
% (n)	Significance	% (n)	Significance	% (n)	Significance	% (n)	Significance	% (n)	Significance	% (n)	Significance	% (n)
χ^2	χ^2	χ^2	χ^2	χ^2	χ^2	χ^2	χ^2	χ^2	χ^2	χ^2	χ^2	χ^2
Student type												
Middle school student	57.8 (177)	0.167	64.1 (196)	0.558	35.9 (110)	0.404	57.8 (177)	0.193	40.2 (123)	< 0.001	41.5 (127)	0.87
High school student	52.3 (160)	1.908	61.8 (189)	0.343	39.2 (120)	0.697	52.6 (161)	1.692	53.9 (165)	11.569	42.2 (129)	0.027
Sex												
Male	50.3 (154)	0.018	59.2 (181)	0.054	29.4 (90)	< 0.001	52.0 (159)	0.104	44.8 (137)	0.257	36.3 (111)	0.005
Female	59.8 (183)	5.554	66.7 (204)	3.704	45.8 (140)	17.414	58.5 (179)	2.643	49.3 (151)	1.285	47.4 (145)	7.763
Experience with cancer												
Yes	65.4 (51)	0.064	69.2 (54)	0.273	50.0 (39)	0.018	65.4 (51)	0.074	61.5 (48)	0.008	51.3 (40)	0.084
No	54.2 (277)	3.426	62.8 (321)	1.203	36.0 (184)	5.631	54.6 (279)	3.195	45.4 (232)	7.066	40.9 (209)	2.989
Conversation with parents regarding cancer												
Yes	69.6 (80)	< 0.001	77.4 (89)	< 0.001	53.9 (62)	< 0.001	60.9 (70)	0.213	54.8 (63)	0.068	52.2 (60)	0.014
No	52.4 (253)	11.115	60.0 (290)	12.046	33.7 (163)	16.095	54.5 (263)	1.551	45.3 (219)	3.322	39.5 (191)	6.083
Cancer education												
Yes	58.6 (140)	0.394	68.2 (163)	0.306	45.2 (108)	0.103	57.3 (137)	0.979	54.4 (130)	0.036	42.3 (101)	0.506
No	54.7 (133)	0.725	63.8 (155)	1.046	37.9 (92)	2.665	57.2 (139)	0.001	44.9 (109)	4.384	45.3 (110)	0.443

 χ^2 , chi-squared statistic

Table 8. Factors associated with Significant Barriers to Help-Seeking

	B	Significance	Exp(B)	95% confidence interval	
				Lower limit	Upper limit
Sex	1.029	< 0.001	2.798	1.727	4.533
Conversation with parents regarding cancer	0.825	0.005	2.281	1.276	4.079
Recognition of warning symptoms of cancer	0.1	0.003	1.106	1.036	1.181

Hosmer–Lemeshow test, $p=0.661$; Nagelkerke R^2 , 0.16

cancer was incurable pain ($\chi^2 = 4.609$, $p = 0.032$). Cancer warning signs widely recognized by students who had conversations about cancer with their parents were unexplained pain ($\chi^2 = 4.746$, $p = 0.029$) and incurable pain ($\chi^2 = 6.439$, $p = 0.011$). Among students who had received cancer education at school, the most widely recognized cancer warning signs were an unexplained lump or swelling ($\chi^2 = 5.995$, $p = 0.025$), unexplained bleeding ($\chi^2 = 5.405$, $p = 0.020$), change in mole ($\chi^2 = 11.735$, $p < 0.001$), and unexplained weight loss ($\chi^2 = 7.968$, $p = 0.005$). There were no significant results for any other factors.

Barriers to help-seeking and individual and environmental factors

Regarding the relationship between barriers to help-seeking item scores and individual and environmental factors, significant chi-squared test results are shown in Table 7. High barriers overall were being too busy to go to the hospital ($\chi^2=11.569$, $p < 0.001$), difficulty securing transportation to the hospital ($\chi^2=15.440$, $p < 0.001$), and difficulty getting a hospital appointment ($\chi^2 = 18.380$, $p < 0.001$). High barriers among females were shame ($\chi^2 = 11.12$, $p = 0.002$), worry about finding something ($\chi^2 = 5.631$, $p = 0.018$), other concerns ($\chi^2 = 7.763$, $p = 0.005$), worry about wasting the doctor's time ($\chi^2 = 5.081$, $p = 0.024$), and difficulty talking to doctors ($\chi^2 = 9.972$, $p = 0.002$). High barriers among students with personal experience of cancer were worry about finding something ($\chi^2 = 5.631$, $p = 0.018$), being too busy to go to the hospital ($\chi^2 = 7.066$, $p = 0.008$), difficulty securing transportation to the hospital ($\chi^2 = 9.017$, $p = 0.003$), and worry about wasting the doctor's time ($\chi^2 = 11.827$, $p < 0.001$). High barriers among students who had conversations about cancer with their parents were shame ($\chi^2 = 11.115$, $p < 0.001$), fear ($\chi^2 = 12.046$, $p < 0.001$), worry about finding something ($\chi^2 = 16.095$, $p < 0.001$), other concerns ($\chi^2 = 6.083$, $p = 0.014$), worry about wasting the doctor's time ($\chi^2 = 13.827$, $p < 0.001$), and difficulty talking to doctors ($\chi^2 = 6.926$, $p = 0.008$). A high barrier for students who received cancer education was being too busy to go to the hospital ($\chi^2 = 4.384$, $p = 0.036$).

Relationships between barriers to help-seeking, individual and environmental factors, risk factors, and warning signs

Multiple logistic regression analysis showed that high barriers to help-seeking included being female (odds ratio [OR]=2.80, 95% CI: 1.73, 4.53, $p < 0.001$), having conversations with parents about cancer (OR=2.28, 95% CI: 1.28, 4.08, $p = 0.005$), and awareness of cancer warning signs (OR=1.04, 95% CI: 1.04, 1.81, $p = 0.003$)

(Table 8).

Discussion

Cancer awareness of Japanese junior and senior high school students

We will now compare the cancer awareness of junior and senior high school students in Japan with that of UK adolescents according to a survey using CAM [16]. In Japan, health and physical education is compulsory, and health education is provided in schools, as in the UK. Effects of school-based cancer awareness interventions have also been reported in the UK [16, 28].

Risk factors

More than 90% of our students recognized smoking and passive smoking as risk factors for cancer. However, less than 50% recognized lack of moderate physical activity, excessive intake of red/processed meat, and HPV/HBV/HCV infection. Thus, awareness of lifestyle habits and viral infections was lacking. The percentage who recognized smoking as a risk factor was high, but awareness of other risk factors was only moderate, similar to UK adolescents [16]. In Japan, policies such as Health Japan 21 promoted smoking countermeasures [29], which is believed to have improved the recognition of smoking and second-hand smoking as cancer risk factors among adolescents. Cancer education is sometimes associated with the prevention of lifestyle-related diseases in Japan [22]; thus, cancer-specific risk factors (e.g., excessive intake of red/processed meat and HPV/HBV/HCV infection) may be difficult to recognize. Therefore, accurate information on cancer-specific risk factors must be provided according to students' level of development.

Cancer warning signs

Few students correctly recognized warning signs, and more than half did not recognize them at all. UK adolescents recognize unexplained lumps or swelling (93.4%), changes in the appearance of moles (64.9%), and changes in defecation and urination habits (54.4%) as risk factors [16]. Recognition of warning signs is lower among Japanese than UK adolescents. Teaching materials promoting cancer education in Japan [24] do not address early symptoms, which can delay the seeking of medical care [9, 30]. Therefore, understanding warning signs should be emphasized.

Barriers to help-seeking

Emotional barriers were the most frequently cited barriers to seeking medical attention in this study, similar

to UK adolescents. In the UK study, emotional barriers included worry the doctor might find something (72%), shame (55.6%), fear (54.4%), and not feeling confident telling the doctor about symptoms (53.3%) [15]. UK school-based educational interventions yielded no long-term efficacy in overcoming barriers to accessing healthcare [16]. Therefore, emotional barriers to medical visits among Japanese adolescents should be further explored to reduce barriers.

Relevant factors for cancer awareness

Factors associated with cancer risk factors and warning signs

Nine cancer risk factors were correctly recognized by our students who had conversations with their parents about cancer, including excessive intake of red/processed meat and HPV/HBV/HCV infection. Parents are the second most used source of information about cancer for junior and senior high school students, after the media [21], and explanations from parents provided to Japanese junior high school girls about HPV vaccination influenced girls' knowledge of uterine cancer and their desire to be vaccinated [31]. Therefore, children acquire might knowledge of risk factors through conversations with their parents. A UK school-based intervention assigned homework to students who had received cancer education to discuss the issue with their parents [15]. Knowledge takes root when an output is created [32]. Therefore, creating opportunities for children and parents to talk about cancer and mutually output the knowledge obtained through discussions could help establish knowledge about cancer risk factors and change parents' behavioral intentions.

Barriers to help-seeking

Being female, conversations about cancer with parents, and recognition of warning signs were barriers to help-seeking in this study. Among Scottish adolescents, anxiety, recognition of cancer warning signs, and being female influenced help-seeking [14], similar to Japanese adolescents. Worry about finding something, an emotional barrier, was frequently seen among female students and those who had conversations about cancer with their parents. The high number of barriers cited by our female students is similar to the situation in British adolescents ($\chi^2 = 22.95$, $p < 0.001$) [15] and Omani adolescents ($\chi^2 = 7.107$, $p < 0.008$). Furthermore, among British adults, women (40%) were more likely than men (34%) to perceive barriers [33], and women tend to have higher levels of worry [34]. Furthermore, Japanese students view cancer as "scary" (72.1%) [35], feeling that cancer patients are pitiable (77.4/70.9%) [36]. However, worry about finding cancer discourages screening [37] and constitutes a reason for delaying the seeking of medical attention to avoid a confirmatory diagnosis [38, 39]. Therefore, considering gender differences in perceptions of barriers/concerns about being diagnosed, we believe explaining the benefits of recognizing the warning signs of cancer is necessary for early detection and treatment. Furthermore, our students who had conversations about cancer with their parents had high barriers to help-seeking

(e.g., worry about finding something); therefore, the level of cancer awareness, of both children and parents, and whether or not children have conversations with their parents, are important.

Limitations

This study has several limitations. First, because a considerable proportion of participants had personal or familial experiences with cancer, selection bias may have occurred. Adolescents from families familiar with cancer may have greater awareness or different perceptions compared with those without such experiences, which could have influenced the results. Second, as this study used an Internet-based survey, participation was limited to individuals with Internet access and parents registered with an online survey company, which may have excluded adolescents from households with different socioeconomic or educational backgrounds. Third, the findings may not be generalizable to all Japanese adolescents, particularly those without any cancer familiarity or those in different cultural or educational environments. Future research should include more diverse populations and compare awareness levels between adolescents with and those without cancer-related experiences to increase the external validity of the findings.

In conclusion, the purpose of this study was to clarify the level of cancer awareness of Japanese adolescents, and relevant factors, and to obtain insight into effective educational intervention methods. Japanese adolescents have insufficient cancer awareness, varying levels of knowledge of cancer risk factors, and low awareness of cancer-specific risk factors. Moreover, our respondents had low awareness of cancer warning signs, and many described emotional barriers to help-seeking. Therefore, in cancer education, ways to highlight cancer-specific risk factors and warning signs in an easy-to-understand manner are needed. Furthermore, students who are female, have conversations about cancer with their parents, and are aware of many cancer warning signs have high barriers to help-seeking, so explaining that recognizing warning signs can lead to early detection of cancer, and that early treatment can lead to cure, is necessary. It is also important to pay attention to the level of awareness of cancer, of both children and parents, the presence/absence of conversations about cancer, and the content thereof.

Author Contribution Statement

Yoko Minamiguchi contributed to Conceptualization, Methodology, Formal analysis, Interpretation of data, and Writing – Original Draft. Kumi Suzuki contributed to Conceptualization, Methodology, Investigation, Formal analysis, Interpretation of data, Writing – Review & Editing, Supervision, and Project administration. Masako Yamanaka, Yasuhiro Tsuda, Yuko Tomari, Naoko Hayashi, Ikue Shino, Eiko Yamauchi, Akiko Fukawa, Tomoki Doi, and Yasuhito Fujisaka contributed to Methodology and Formal analysis. All authors read and approved the final manuscript.

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General

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Data Availability

The study data are available on reasonable request to the first author.

Study Registration

This study was not registered in any registry.

Ethical Declaration

This study was approved by the Ethics Review Board of Osaka Medical and Pharmaceutical University (approval number: 2021-117).

Conflict of Interest

The authors have no conflicts of interest to disclose

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