RESEARCH ARTICLE

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Factors Related to Cancer Screening Behaviors of Junior High and High School Teachers in Japan: A Cross-Sectional Survey

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Abstract

Background: Because some cancers can be detected early in their progression, regular screenings should be promoted to ensure timely diagnosis. In Japan, cancer education has become compulsory in junior and high schools; however, research on the cancer screening behaviors of teachers is limited. This study aimed to clarify the factors related to cancer screening behaviors among junior and high school teachers in Japan. **Methods:** This cross-sectional study collected data through an online survey that included questions about nationally recommended screenings for lung, colon, gastric, breast, and cervical cancers, as well as items on the Cancer Awareness Measure survey. Descriptive statistics were used for socio-demographic data, survey information, and cancer screening behavior. Chi-square tests and t tests were conducted to examine the relationships among these variables. Multiple logistic regression analyses were used to identify factors influencing screening behavior. **Result:** The respondents were 316 junior high school teachers and 463 high school teachers (238 females, 541 males; average age 48.2 years; average teaching experience 23.5 years). Approximately 48%–64% of participants regularly underwent screening for all cancers. The results showed that screening rates increased with age. Common factors influencing the uptake of lung, colorectal, gastric, and breast cancer screening included: the target age group for cancer screening, the type of school, and recognition of cancer warning signs. Participants who were within the target screening age group, who worked at national or public schools, and who had higher recognition of cancer warning signs were more likely to undergo cancer screening. **Conclusion:** The results of this study will aid the development of interventions for Japanese teachers that will increase their participation in cancer screenings. Programs that increase knowledge of cancer warning signs, as well as those that specifically target younger teachers and those in private schools, will be particularly useful.

Keywords: Early detection of cancer, Cancer awareness, School teachers, Cross-sectional studies, Japan, Logistic models

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Introduction

Cancer is responsible for almost one in six deaths (16.8%) worldwide, and nearly one in four deaths (22.8%) from noncommunicable diseases [1]. In Japan, one in two people will develop cancer, and it will result in mortality for one in four men and one in six women [2]. For men <69 years of age, the cancers with the highest incidence and mortality rates are lung, colon, and gastric cancers. These are the same for women, with the addition of breast and uterine cancers [2]. Because these types of cancers can be detected and treated early in their progression, regular screenings are critical [3].

Cancer screening programs in Japan include resident health checkups conducted by municipalities, workplace checkups conducted by employers and insurers, and voluntary cancer screenings procured by individuals at their own expense [4]. Established guidelines from the Ministry of Health, Labour and Welfare of Japan promote evidence-based screening by municipalities; these are available for cervical cancer to residents aged ≥20 years, for lung, colon, and breast cancers for those ≥40 years, and for gastric cancer for those ≥50 years. Screenings are recommended every one to two years. The cost of cancer screening is partially subsidized by public funds, which allows people to receive screenings at a low self-pay rate [5].

Since the first Basic Plan for Promoting Cancer Control was established in 2007, the Ministry of Health, Labour and Welfare began implementing measures such as distributing coupons for free screenings and promoting participation in the workplace, with the goal of achieving a 50% uptake rate [6]. By 2017, the national overall screening rate had reached 40–50% [2]. However, the rate for breast and cervical cancers remained in the 40% range, compared with 60–80% in other member

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countries of the Organization for Economic Co-operation and Development [7]. Despite the efforts to increase and improve access to screenings, mortality rates for breast, cervical, and colorectal cancers have not substantially declined relative to other countries [8].

To combat these low screening and stagnant mortality rates, the Third Basic Plan for Promoting Cancer Control included public cancer education and raising awareness [9]. One component of this plan was the introduction of cancer education in junior high and high schools beginning in 2021 [10, 11]. These programs were intended not only to be informative to students but also to help them develop lifestyle choices conducive to maintaining good health [12]. Accordingly, teachers are expected to promote cancer education while also serving as role models for health-related behaviors. Therefore, it is important not only to raise their awareness of cancer, but also to encourage behavioral changes regarding undergoing cancer screening. This study aimed to clarify the cancer screening behaviors of junior high and high school teachers in Japan as well as their associated factors. The data originated from a prior survey concerning the cancer awareness of teachers and their perceptions of and approaches to cancer education.

Materials and Methods

Study design

This was a cross-sectional study conducted in Japan.

Conceptual framework of this study

As illustrated in Figure 1, the framework of this study was based on the assumption that individual factors (such as age, sex, educational level, and cancer experiences of close acquaintances) and environmental factors (such as school type and cancer education), as well as attitudes toward cancer, are associated with cancer screening behaviors, including participation in lung, gastric, and colorectal cancer screenings.

Setting and sample

The participants were teachers at junior high and high schools in Japan who were registered as monitors with Neo Marketing Incorporated (Neo Marketing), an internet research company.

Participants were required to be: 1) full-time teachers working at junior high or high schools, 2) registered as monitors with Neo Marketing, and 3) willing to cooperate with this study.

The minimum sample size needed for this study was 384 participants. This was determined using the formula $n=\lambda^2 p(1-p)/d^2$ [13]. Assumptions included a response rate of 0.5, a sampling error of 5%, and a confidence level of 95% ($\lambda=1.96$), since the response rate with the largest error was 0.5. Therefore, the sample size was set at 400 teachers from junior high and 400 from high school, for a total of 800 individuals.

The method of quota sampling was based on the 2021 Ministry of Education, Culture, Sports, Science and Technology Statistical Abstract [14, 15]. This was used to ensure equal composition ratios related to age, sex, and region.

Data collection

Data were collected via an anonymous online questionnaire conducted in December 2021. Sampling and data collection continued until 800 participants had completed the survey.

As this was an internet-based survey, the questionnaire employed a forced response design in which participants could not proceed to the next screen without completing all required items. Therefore, no missing data were generated in this study.

Survey instruments

Cancer screening behaviors

The questionnaire included items regarding screening uptake behavior for lung, gastric, and colorectal cancers, as defined by the cancer screening guidelines of Japan [16]. Additional screenings for breast and cervical cancers were included for women. Specifically, lung cancer screening consisted of a chest X ray examination with or without sputum cytology for high risk individuals; gastric cancer screening consisted of upper gastrointestinal endoscopy or barium X ray examination; and colorectal cancer screening refers to the fecal occult blood test. Additional screenings for women included breast cancer screening (mammography) and cervical cancer screening (Pap

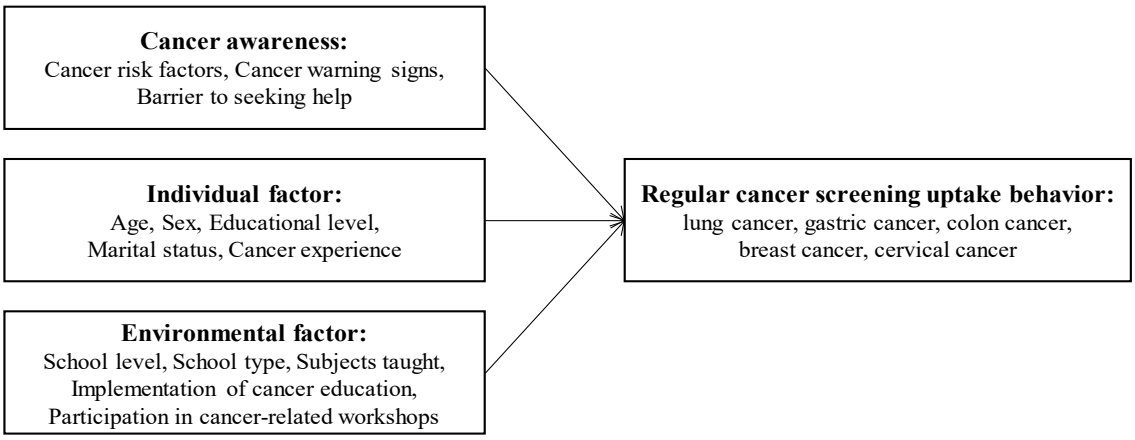

Figure 1. Conceptual Framework

smear cytology). Participants were also asked whether they received regular cancer screenings once a year or once every two years. In addition, participants were asked about specific experiences with each of the five screening tests or, if applicable, why specific tests might have been declined.

Factors related to cancer screening behaviors

Factors related to cancer screening uptake were identified as: overall cancer awareness, individual factors, and environmental factors. Cancer awareness was assessed using the Cancer Awareness Measure (CAM) developed by Cancer Research UK [17]. The CAM consists of nine independent modules. This study used 30 items from the CAM: 9 cancer warning signs from Module 2, 10 barriers to seeking help from Module 4, and 11 cancer risk factors from Module 6. All items were translated into Japanese. However, because cancer risk factors differ slightly among countries, we changed "sunburn" to "excessive salt intake" based on the risk factors proposed by the National Cancer Center Prevention Research Group [18]. Each item was scored based on its associated risk factors; responses of "Strongly agree" or "Agree" were assigned 1 point; all other responses received 0 points. The total score ranged from 0 to 11. For warning signs, a response of "Yes"=1 point and "No" or "Don't know"=0 points each, resulting in a total score range of 0 to 9. Barriers to seeking help were scored as follows: "Frequently"=2 points, "Occasionally"=1 point, and "None" or "Don't know"=0 points, with a total score ranging from 0 to 20. Higher scores in all categories indicated greater awareness of cancer and stronger recognition of potential barriers to screenings.

The internal reliability of each CAM module was confirmed by the following: Cronbach's α=0.79 for risk factors, Cronbach's α=0.77 for warning signs, and Cronbach's α=0.73 for barriers to seeking help [19]. Although evidence suggests that CAM can be researched via the Internet [20], Cancer Research UK was contacted, and permission was obtained to use CAM for the present study (personal communication).

Sociodemographic data for individual factors were based on questions from the CAM [17] and included gender, age, highest level of education, marital status, and cancer experiences of spouses, other close family members, relatives, and close friends/acquaintances. The researchers also determined that the following factors were involved: school level, school type, the subject taught, how cancer education was introduced at the school, and participation in cancer-related training sessions.

Statistical Analyses

Data were analyzed using IBM SPSS Statistics for Windows, Version 29.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used for cancer screening behavior, sociodemographic data, and questions from each CAM module. Participants were classified into those who regularly underwent cancer screenings and those who did not; these categories were used as dependent variables in the univariate analysis (chi-square tests and t tests). The other variables, such as awareness of cancer, individual factors, and environmental factors, were used as independent variables. Multiple logistic regression analysis was conducted using cancer screening uptake as the dependent variable. Variables with a p-value <0.25 in the univariate analysis were included as covariates. Variable selection was performed using the forced entry method. Age was categorized based on eligibility for cancer screening for lung, colorectal, and breast cancer. Participants were divided into those <40 years and those ≥40 years; for gastric cancer, the cutoff was 50 years. Age was excluded from the cervical cancer analysis because screening is recommended for all individuals aged ≥20 years. Participants who selected "prefer not to answer" for target attributes such as educational background or marital status were excluded from the analysis. A p-value <0.05 was considered statistically significant.

Ethical considerations

This study was approved by the Research Ethics Committee of Osaka Medical and Pharmaceutical University (No. 2021-093). Prior to obtaining consent, the participants were informed online of the purpose of the study and that the results would be made public. They were assured that their responses to the questionnaire were voluntary and anonymous. Those who agreed to participate indicated their consent by checking a box labeled "I agree."

Results

Socio-demographic characteristics

A total of 800 people were surveyed. Among these, 779 (97.4%) valid responses were obtained; 316 were from junior high school teachers (40.6%) and 463 were from high school teachers (59.4%). The average age was 48.2 years (SD=10.8), and the cohort included 238 women (30.6%) and 541 men (69.4%). The average teaching experience was 23.5 years (SD=11.3). A total of 126 participants (16.2%) answered that cancer education was implemented at their schools, and only 83 (10.7%) had participated in a cancer-related workshop. Other characteristics are shown in Table 1.

Cancer screening behaviors

The proportions of teachers who had undergone regular cancer screening once or twice per year were as follows: lung, 64.1%; gastric, 63.2%; colorectal, 51.7%; breast, 49.2%; and cervical, 48.3%.

Supplementary Table 1 and Table 2 show that a greater proportion of participants ≥ 40 years regularly underwent cancer screening. Among participants within the target screening age group, regular screening rates were as follows: lung, 70.3%; gastric, 80.7%; colorectal, 60.7%; breast, 70.5%; and cervical, 48.3%.

A total of 113 respondents did not undergo cancer screening. The primary reasons for their decisions were as follows: "I don't have time to go to a cancer screening" (n=52); "I'm not at the age to undergo cancer screening" (n=36); "I'm afraid that cancer will be found during a cancer screening" (n=23); and "I'm confident in my health, so there's no need for cancer screening" (n=23).

Table 1. Cancer Screening Uptake by Participants' Sociodemographic Characteristics (n = 779)

Characteristics	n	%
Age (years)		
20–29	49	6.3
30–39	140	18.0
40–49	201	25.8
50–59	279	35.8
≥60	110	14.1
Sex		
Female	238	30.6
Male	541	69.4
Education level		
Bachelor's degree	637	81.8
Master's or doctoral degree	126	16.2
Prefer not to say	16	2.0
Marital status		
Married	563	72.3
Single, divorced, or widowed	214	27.5
Prefer not to say	2	0.2
Any cancer experience (self/partner/close family/relatives/ friends)		
Yes	468	60.1
No	289	37.1
Don't know	11	1.4
Prefer not to say	11	1.4
Cancer experience by relationship (cumulative number of participants)		
Self	42	5.4
Partner	28	3.6
Close family	327	42.0
Relatives	284	36.5
Close friends/acquaintances	212	27.2
School level		
Junior high school	316	40.6
High school	463	59.4
School type		
National	19	2.4
Public	587	75.4
Private	173	22.2
Area of school		
Hokkaido and Tohoku	110	14.1
Kanto (Kanto and Keihin)	225	28.9
Chobu (Koshinetsu, Hokuriku, Tokai)	134	17.2
Kinki (Kinki and Hanshin)	151	19.4
Chogoku and Shikoku	70	9.0
Kyusyu and Okinawa	89	11.4
Subject taught		
Liberal arts	302	38.8
Science	242	31.1
Art	31	4.0
Subject taught		
Health and sports	80	10.2
Other	124	15.9
Implementation of cancer education in your school		
Yes	126	16.2
No	593	76.1
Don't know	60	7.7
Participation in cancer-related workshops		
Yes	83	10.7
No	668	85.7
Don't know	28	3.6
Any previous cancer screening (any type)		
Yes	646	82.9
No	133	17.1
Previous screening by cancer site (cumulative number of participants)		
Lung	515	66.1
Gastric	562	72.1
Colon	498	63.9
Breast (women only) ※	155	65.1
Cervical (women only) ※	158	66.4

Note: ※ Indicates that breast and cervical cancer screenings are for women only.

Factors related to cancer screening behaviors

Lung cancer screening

Supplementary Table 1 shows that participants who underwent regular lung cancer screening (screening group) were significantly older than those who did not (non-screening group) ($p<0.001$). The screening group also included more men (66.5%), married participants (65.9%), and those who had relatives with cancer (68.3%). Significant differences were observed by sex ($p<0.001$), marital status ($p<0.001$), and cancer experience with relatives ($p=0.003$). The screening group also had significantly higher scores for awareness of cancer warning signs than the non-screening group ($p<0.001$) (Table 3).

Multiple logistic regression analysis revealed that lung cancer screening behavior was significantly associated with age (OR: 4.218, 95% CI: 2.821–6.308, $p<0.001$), school type (OR: 1.553, 95% CI: 1.056–2.283, $p=0.025$), and awareness of cancer warning signs (OR: 1.107, 95% CI: 1.053–1.164, $p<0.001$).

Gastric cancer screening

Participants in the gastric cancer screening group were significantly older than those in the non-screening group ($p<0.001$) (Supplementary Table 1). The screening group also included more men, married participants, and those with close family members, relatives, or close friends/ acquaintances with cancer (67.9%, 73.6%, and 74.1%, respectively), as well as participants from national/public schools (66.3%). Significant differences were observed

Table 2. Associations between Breast and Cervical Cancer Screening Uptake and Sociodemographic Characteristics (n = 238)

Variable		n (%)	Regular breast cancer screening					Regular cervical cancer screening				
			Yes n (%)	No n (%)	χ^2-value	p-value	φ coefficient	Yes n (%)	No n (%)	χ^2-value	p-value	φ coefficient
Age	20–29	37 (15.5)	5 (13.5)	32 (86.5)	50.329	<0.001	※0.460	17 (45.9)	20(54.1)	7.664	0.053	※0.179
	30–39	79 (33.2)	26 (32.3)	53 (67.1)				29 (36.7)	50(63.3)			
	40–49	62 (26.1)	41 (66.1)	21 (33.9)				35 (56.5)	27 (43.5)			
	≥50	60 (25.2)	45 (75.0)	15 (25.0)				34 (56.7)	26 (43.3)			
Marital status	Married	131 (55.3)	69 (52.7)	62 (47.3)	1.628	0.240	0.083	69 (52.7)	62 (47.3)	2.018	0.191	0.092
	Single, divorced, or widowed	106 (44.7)	47 (44.3)	59 (55.7)				46 (43.4)	60(56.6)			
Education level	Bachelor's degree	195 (85.2)	92 (47.2)	103 (52.8)	0.000	1.000	-0.001	91 (46.7)	104 (53.3)	0.076	0.853	0.018
	Master's or doctoral degree	34 (14.8)	16 (47.1)	18 (52.9)				15 (44.1)	19 (55.9)			
Cancer experience												
Partner	Yes	7 (3.1)	3 (42.9)	4 (57.1)	0.077	1.000	-0.018	3 (42.9)	4 (57.1)	0.090	1.000	-0.020
	No/Don't know	218 (96.9)	105 (48.2)	213 (51.9)				106 (48.6)	112 (51.4)			
Close family	Yes	91 (39.6)	47 (51.6)	44 (48.4)	0.382	0.590	0.041	44 (48.4)	47 (51.6)	0.000	1.000	0.001
	No/Don't know	139 (60.4)	66 (47.5)	73 (52.5)				67 (48.2)	72 (51.8)			
Relatives	Yes	84 (36.7)	55 (65.5)	29 (34.5)	14.573	<0.001	0.252	45 (53.6)	39 (46.4)	2.187	0.170	0.098
	No/Don't know	145 (63.3)	57 (39.3)	88 (60.7)				63 (43.4)	82 (56.6)			
Close friends or acquaintances	Yes	58 (25.1)	39 (67.2)	19 (32.8)	10.406	0.001	0.212	32 (55.2)	26 (44.8)	1.573	0.227	0.083
	No/Don't know	173 (74.9)	74 (42.8)	99 (57.2)				79 (45.7)	94 (54.3)			
School level	Junior high school	113 (47.5)	55 (48.7)	58 (51.3)	0.020	0.897	-0.009	56 (49.6)	57 (50.4)	0.132	0.795	0.024
	High school	125 (52.5)	62 (49.6)	63 (50.4)				59 (47.2)	66 (52.8)			
School type	National/public	204 (85.7)	105 (51.5)	99 (48.5)	3.051	0.096	0.113	103 (50.5)	101 (49.5)	2.695	0.137	0.106
	Private	34 (14.3)	12 (35.3)	22 (64.7)				12 (35.3)	22 (64.7)			
Subjects taught	Health and sports	31 (13.0)	16 (51.6)	15 (48.4)	0.086	0.848	0.019	17 (54.8)	14 (45.2)	0.607	0.449	0.050
	Other	207 (87.0)	101 (48.4)	106 (51.2)				98 (47.3)	109 (52.7)			
Implementation of cancer education in your school	Yes	38 (16.0)	19 (50.0)	19 (50.0)	0.013	1.000	0.007	22 (57.9)	16 (42.1)	1.660	0.218	0.084
	No/Don't know	200 (84.0)	98 (49.0)	102 (51.0)				93 (46.5)	107 (53.5)			
Participation in cancer-related workshops	Yes	31 (13.0)	21 (67.7)	10(32.3)	4.924	0.034	0.144	17 (54.8)	14 (45.2)	0.607	0.449	0.050
	No/Don't know	207 (87.0)	96 (46.4)	111 (53.6)				98 (47.3)	109 (52.7)			

Note: Univariate analysis was conducted using the chi-square test. ※ indicates the value of Cramér's V.

Table 3. Associations between Regular Cancer Screening Uptake and Cancer Awareness

Variable		n	Cancer risk factors		Cancer warning signs		Barrier to seeking help	
			Average ± SD	p-value	Average ± SD	p-value	Average ± SD	p-value
Cancer awareness measure score		779	5.41±3.280		4.52±3.300		4.51±4.070	
Regular lung cancer screening	Yes	478	5.45±3.137	0.645	4.86±3.178	p<0.001	4.48±3.768	0.809
	No	301	5.34±3.509		3.98±3.416		4.55±4.523	
Regular gastric cancer screening	Yes	492	5.39±3.127	0.868	4.74±3.188	0.018	4.46±3.768	0.676
	No	287	5.43±3.542		4.15±3.453		4.59±4.556	
Regular colon cancer screening	Yes	403	5.43±3.271	0.818	4.83±3.243	0.007	4.55±4.008	0.777
	No	376	5.38±3.302		4.19±3.329		4.47±4.148	
Regular breast cancer screening	Yes	117	6.33±3.449	0.212	5.31±3.193	0.221	5.08±4.005	0.414
	No	121	5.79±3.310		4.49±3.374		5.50±4.048	
Regular cervical cancer screening	Yes	115	6.30±3.532	0.289	5.11±3.308	0.748	5.16±3.736	0.611
	No	123	5.83±3.236		4.98±3.285		5.42±4.287	

Note: Univariate analyses were conducted using the t-test.

by sex (p<0.001), marital status (p<0.001), cancer in close family members (p=0.033), relatives (p<0.001), and close friends/acquaintances (p<0.001), as well as by school type (p=0.001). Furthermore, the screening group had significantly higher scores for awareness of cancer warning signs (p=0.018) (Table 3).

Multiple logistic regression analysis revealed that gastric cancer screening behavior was significantly associated with age (OR: 3.681, 95% CI: 2.557–5.300, p<0.001), sex (OR: 1.940, 95% CI: 1.318–2.857, p=0.001), marital status (OR: 1.534, 95% CI: 1.047–2.247, p=0.028), cancer experience in relatives (OR: 2.004, 95% CI: 1.315–3.054, p=0.001), school type (OR: 2.208, 95% CI: 1.473–3.312, p<0.001), and awareness of cancer warning signs (OR: 1.075, 95% CI: 1.020–1.132, p=0.007).

Colon cancer screening

Participants in the colorectal cancer screening group were significantly older than those in the non-screening group (p<0.001). The screening group also included more men (56.4%), married participants (55.1%), and those with cancer in close family members (56.6%), relatives (59.5%), or close friends/acquaintances (58.5%). Significant differences were observed by sex (p<0.001), marital status (p=0.002), and cancer experience in close family (p=0.028), relatives (p=0.001), and close friends/acquaintances (p=0.023). The screening group also had significantly higher scores for awareness of cancer warning signs (p=0.007) (Supplementary Table 1 and Table 3).

Multiple logistic regression analysis revealed that colorectal cancer screening behavior was significantly associated with age (OR: 4.770, 95% CI: 3.107–7.325, p<0.001), school type (OR: 1.545, 95% CI: 1.054–2.264, p=0.026), and awareness of cancer warning signs (OR: 1.079, 95% CI: 1.027–1.133, p=0.003).

Breast cancer screening

Participants in the breast cancer screening group were significantly older than those in the non-screening group (p<0.001). The screening group also included significantly more participants who had relatives (65.5%; p<0.001) or close friends/acquaintances (67.2%; p=0.001) with cancer, as well as more participants who had attended cancer-related workshops (67.7%; p=0.034). However, no significant association was found for cancer awareness (Tables 2 and 3).

Multiple logistic regression analysis revealed that breast cancer screening behavior was significantly associated with age (OR: 5.867, 95% CI: 3.169–10.862, p<0.001), cancer experience in relatives (OR: 1.993, 95% CI: 1.029–3.859, p=0.041), and school type (OR: 2.629, 95% CI: 1.018–6.786, p=0.046).

Cervical cancer screening

Participation in cervical cancer screenings was highest among those in their 50s (56.7%), followed by those in their 40s (56.5%) and 20s (45.9%). However, no significant differences by age were observed, nor were there associations found with any other factors (Tables 2 and 3).

Multiple logistic regression analysis did not identify any factors significantly associated with cervical cancer screening behavior.

Discussion

This study represents the first nationwide investigation in Japan to comprehensively examine factors associated with cancer screening behaviors among junior high and high school teachers, including their awareness of cancer. In light of the increasing importance of cancer education, these findings offer valuable baseline information for developing strategies to promote cancer screening behaviors among teachers and to strengthen the effectiveness of cancer education in schools.

Regular cancer screening behaviors among teachers

The rates of regular cancer screenings among teachers within the target age group were 60%–80% for lung, gastric, colorectal, and breast cancers, and 48.3% for cervical cancer. These rates exceed the national averages of 47%–53% for men and 36%–47% for women [2]. These relatively high rates might be explained by the

educational background and professional responsibilities of teachers. This idea is supported by Gabriele et al. [21], who showed that lower educational attainment was strongly associated with reduced cancer screening rates. Moreover, the responsibility of delivering health education to students may cause teachers to be more attuned to their own health management and foster a proactive attitude toward preventive care. For example, a breast cancer screening education intervention conducted among Yemeni female teachers in Malaysia found that "teachers, through their daily contact with students, serve as agents of health education and have the power to transmit health behaviors to future generations" [22]. This statement underscores the important role of teachers as promoters of health behaviors.

The most frequently reported reasons for not undergoing regular cancer screening included "lack of time," "not being in the target age group," "fear of being diagnosed with cancer," and "confidence in one's health." These responses were consistent with findings from a Cabinet Office public opinion survey [23]. Similarly, studies conducted outside Japan have identified "time constraints," "fear," "embarrassment," and "overconfidence in health" as major impediments to cancer screenings [24]. Thus, although teachers demonstrate higher screening rates than the general population, they still face temporal, psychological, and cognitive barriers. To further improve cancer screening participation, greater attention to workplace environments and strengthened educational campaigns is essential.

Factors associated with cancer screening behaviors of teachers

Multiple logistic regression analysis showed that age, cancer experience among close family, close friends/acquaintances, school type, and awareness of cancer warning signs were common factors (although associations varied by cancer type) related to screening behaviors. Age was significantly associated with screening behaviors for all cancers except cervical cancer. Higher age was also linked with higher screening participation, indicating that age is a major predictor. This is consistent with previous research indicating that age is one of the strongest predictors of cancer screening participation among adults aged 50 and older [25]. This may reflect the increased risk of cancer that occurs with aging [26]. Heightened health awareness also tends to increase with age. Among older adults, increased awareness of disease risk and more frequent contact with healthcare providers are associated with greater motivation to undergo screening [27].

Experience with cancer among close family, relatives, and close friends/acquaintances was significantly associated with gastric, colorectal, and breast cancer screening behaviors, and was a predictive factor for gastric and breast cancer screening. This observation is consistent with prior research. For example, Akiyama et al. [28] reported that individuals who had experienced cancer among close family, relatives, or friends were more likely to undergo screening and demonstrated greater risk awareness. Similarly, Bostean et al. [29] found that individuals with a family history of cancer had significantly higher participation in breast and colorectal cancer screening, suggesting that psychological influences and heightened health awareness are contributing factors.

The school type was associated with screening behaviors for lung, gastric, colorectal, and breast cancers. Higher screening participation occurred among national and public school teachers than among those at private schools. This disparity may be attributable to differences in institutional support systems. As local public servants, teachers at national and public schools are eligible for occupational health examinations. In addition, cancer screening is provided as part of routine health examinations offered by many public employers [30]. However, the quality and frequency of occupational health examinations vary for employees of private institutions. Watanabe et al. [31] reported that workers employed in private organizations had lower rates of cancer screening and significantly higher risks of non-participation. Ihara [32] noted that the items included in health examinations varied depending on company size and contract conditions. For example, some excluded cancer screening or required out-of-pocket payment. Le Bonniec et al. [33] highlighted that workplace environment and institutional background influenced screening participation. These structural disparities underscore the need for future policy improvements.

Higher awareness of cancer warning signs was significantly linked with higher screening participation for lung, gastric, and colorectal cancers. This finding suggests that screening behavior is connected to greater health literacy and is consistent with the Health Belief Model, particularly the constructs of "perceived severity of disease" and "perceived benefits of action" [34]. In a large-scale UK study, Robb et al. [35] reported that individuals with greater awareness of cancer warning signs were more likely to participate in screening, and that, among younger populations, misinterpretation or underestimation of symptoms contributed to delays in screening. Other studies have shown that improving awareness of cancer warning signs increased participation in cervical, breast, and colorectal cancer screenings [36]. Together, these findings support the effectiveness of educational interventions and underscore the critical role of awareness in cancer screening participation. Future cancer awareness efforts should incorporate information provision and psychological support to deepen understanding of warning signs and the benefits of screening.

Limitations

This study has some limitations. First, the participants were limited to individuals registered with a specific internet survey company; therefore, potential selection bias should be considered when interpreting and generalizing the findings.

Second, this study was based on a cross-sectional survey; therefore, causal relationships cannot be inferred. Future research should include mixed methods designs that integrate both quantitative and qualitative approaches. By examining how perceptions and awareness of cancer differ between individuals who undergo cancer screening

and those who do not, and how these perceptions shape screening behaviors, studies may offer deeper insights into effective educational strategies to promote cancer screening participation.

Third, qualitative factors such as workplace environment and institutional support were not assessed in this study and thus remain important areas for future investigation.

Despite these limitations, the present study provides valuable insights into the current status and determinants of cancer screening behaviors among teachers, contributing to ongoing efforts to enhance the effectiveness of cancer education.

In conclusion, cancer screening behaviors among teachers in this study were influenced by a complex interplay of individual attributes, institutional factors, and cognitive factors. These findings demonstrate that understanding the health behaviors of teachers is essential for enhancing the effectiveness of cancer education. This study provides a foundation for guiding future educational and policy interventions.

In addition to delivering cancer education, teachers serve as important role models for health behaviors within their communities. The results of this study provide valuable baseline data for the development of strategies to strengthen cancer education. Moving forward, it will be critical to address temporal, psychological, and institutional barriers to screening through improved workplace environments and enhanced awareness initiatives.

Author Contribution Statement

KS contributed to the entire research process, including preparation of the research protocol, data collection, data analysis, and preparation of the manuscript. Authors MY, YM, NH, TD, and YT contributed to the preparation of the research protocol and data analysis. All authors read and approved the final manuscript.

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General

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Approval

This study was approved by the Research Ethics Committee of Osaka Medical and Pharmaceutical University (No. 2021-093).

Ethical Declaration

This study was approved by the Research Ethics Committee of Osaka Medical and Pharmaceutical University (No. 2021-093). Prior to obtaining consent, the participants were informed online of the purpose of the study and that the results would be made public. They were assured that their responses to the questionnaire were voluntary and anonymous.

Data Availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflict of Interest

None.

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