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A questionnaire survey of cervical and breast cancer screening among female employees and employees' spouses

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In Japan, cancer screening is conducted under a variety of umbrellas, i.e., via population-based screening, occupational health checkups, insured medical care, and personal medical checkups. Quality control assessment of cancer screenings is conducted by national and local governments only for population-based screenings. The purpose of this study was to clarify the status of women receiving cervical and breast cancer screenings in Japan by any of these means. As a model associated with occupational screenings, we surveyed female employees and male employees' spouses of Sunstar, Inc., a Japanese subsidiary of an international corporation. The number of valid responses collected from March to July 2023 was 345. Among those who had cancer screening either regularly or irregularly, 66% (89/134) and 56% (47/84), respectively, received cervical and breast cancer screenings more frequently than every two years, the prescribed interval for population-based screening. Our survey revealed that a small number of women are routinely receiving cervical and breast cancer screenings more frequently than appropriate, suggesting a need to provide better information to screening consumers and providers on what constitutes appropriate screening schedules. Our survey also revealed that there is no governmental management entity for opportunistic screenings, so the status among female employees and male employee's spouses of a company, Sunstar, Inc. is unclear.

Keywords Japan, Cervical cancer screening, Breast cancer screening, Occupational health checkup, Quality control assessment of cancer screenings

Abbreviations

HPV	Human papillomavirus
CIN	Cervical intraepithelial neoplasia
FY	Fiscal year
MHLW	Ministry of Health Labour and Welfare

Background

In Japan, the previously declining incidence of cervical and breast cancers has reversed course over the past several decades. Historically, in the late 1970s, cervical cancer was declining because of improved cervical pre-cancer screening, but around 2000 this trend reversed and cases have increased sharply[1]. In 2019, 10,879 women were diagnosed with cervical cancer and 2,887 died from it in 2020[2]. The incidence and mortality rates for cervical cancer are 16.8 and 4.6, respectively, per 100,000 women[2].

Cervical cancer is predominantly caused by integration into the host genome of high-cancer-risk strains of the human papillomavirus (HPV); the cancer is further promoted by habitual smoking[3]. Despite a recent decline in smoking by Japanese women, the increased risks of earlier HPV infection due to an earlier age of initiation of

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sexual intercourse has resulted in the recent increase in cervical cancer among women in their 20s to 40s[4]. This unfortunate trend is predicted to continue well into the future[5].

Cervical cancer screening by cytological diagnosis is an established strategy for secondary intervention against the advancement of abnormalities in cervical cancer. In England, cervical cancer incidence decreased rapidly following an increase in cervical screening rate due to the development of a national reach-out call-and-recall system and incentive payments to general practitioners[6]. In Japan, the national cancer screening rate has not yet reached 50%, although it is slowly increasing due to the implementation of a free-screening coupon system and other measures[7,8].

Cervical cancer screening is an effective secondary prevention measure, but its negatives include less than perfect standalone sensitivity, with significant false negatives and false positives, overdiagnosis concerning the spontaneous resolution of precancerous lesions, and the risk of increased premature delivery due to conization for cervical intraepithelial neoplasia stage 3 (CIN3)[9,10].

The best primary prevention of cervical cancer is HPV vaccination. In Japan, public subsidies for HPV vaccination began in fiscal year 2010 (FY2010) as an emergency promotion program; it was a huge success and became a routine vaccination program in April 2013[11]. From FY 2010 to 2012, the HPV vaccination rate in age-eligible teen girls exceeded 70%[12]. However, following media reports of potentially serious adverse side effects, Japan's Ministry of Health, Labour, and Welfare (MHLW) announced the suspension of its proactive recommendation for the HPV vaccine in June 2013. These events had long-lasting negative effects on HPV vaccination coverage, a condition which dragged on for almost eight years[13]. Finally, in FY2022, the MHLW rebooted its recommendations for the HPV vaccine and also began a three-year catch-up vaccination program to reach back to unvaccinated women.

The effectiveness of HPV vaccination in the prevention of cervical cancer has been widely reported in other countries[14,15]. Of note, Japan was slow to introduce the HPV vaccine, and then, for eight years, a baseless extreme HPV vaccine hesitancy robbed a generation of girls of the protection they deserved. As a result, the effectiveness of HPV vaccination, the primary means of cervical cancer prevention, has been stymied in Japan, leading to predictions of future increases in cervical cancer incidence in Japan[16–18]. The fallback for prevention will be cervical cancer screening, so recommendations regarding screening need to be strengthened[19].

As with cervical cancer, the incidence of breast cancer in Japan has also recently increased significantly; 97,142 people were diagnosed with breast cancer in 2019, and 14,650 died in 2020; incidence and mortality rates from breast cancer are 150.0 and 23.1, respectively, per 100,000 women[20]. Mortality rates for women with breast cancer in Japan and South Korea are increasing and approaching rates observed in non-Asian countries[21]. Risk factors for the development of breast cancer included low age at menarche, high age at menopause, never having had a baby, high age at first birth, and never having breastfed[22]. Significant increases in incidence due to westernization of lifestyles in some parts of Asia are predicted to lead to higher future global breast cancer rates[23].

Breast cancer screening is an effective preventive strategy against breast cancer mortality. A combined analysis of several randomized controlled trials in subjects aged 40–74 showed a reduction in breast cancer mortality associated with mammographic screening, and it is now a recommended population-based screening[24,25]. The negatives of breast cancer screening include examination pain, radiation exposure, and overdiagnosis due to false positives[24].

Japan's cancer screening is divided into two main categories: population-based screening and opportunistic screening[26]. Population-based screening is conducted to reduce the mortality rate for the entire population. In Japan, this category corresponds to cancer screening for residents conducted by local governments. On the other hand, opportunistic screening includes cancer screenings other than population-based screening. This latter category corresponds to occupational health checkups, insured medical care, and personal medical checkups.

For Japan's population-based screening, cervical cancer screening is recommended once every two years for women aged 20 and older, whereas breast cancer screening is recommended once every two years only for women aged 40 and older. The Comprehensive Survey of Living Conditions conducted by the Household Statistics Office of the MHLW asks whether a person has received a cancer screening within the past two years, and this information provides the following estimate of the cancer screening rate in Japan. In their FY2022 survey, the cervical cancer screening rate in the past two years was 43.6% among those aged 20–69, and the breast cancer screening rate was 47.4% among those aged 40–69[8]. However, details such as which types of cancer screening were received and how often they were received were unknown.

Each local government manages its cancer screening data, such as uptake, recall, work-up examination rates, the rate of not knowing about screening, the cancer detection rate, and the acceptable value of the positive predictive value as process indicators for population-based screening[27]. In addition, there is no governmental management entity for opportunistic screenings (occupational health checkups, insured medical care, and personal medical checkups), so their status is unclear.

The purpose of our newest study was to clarify the status of cervical cancer and breast cancer population-based screening, occupational health checkups, insured medical care, and personal medical checkups among female employees and male employee's spouses of a company, Sunstar, Inc.

Materials and methods

Data collection

The Sunstar Group is a cluster of subsidiaries of Sunstar SA based in Switzerland. The Japanese subsidiary Sunstar KK is headquartered in Takatsuki City, Osaka Prefecture, Japan. Their occupational healthcare system started as a corporate welfare program in 2008. The number of eligible Sunstar Group female employees and the spouses of male employees present during the survey period of March 15 and July 20, 2023, was a total of 1,815 women. Female employees were asked by the company to cooperate with our survey in person. Married male

employees were asked to have their spouses complete the survey. Leaflets with a QR code were distributed and responses were collected through a Google questionnaire form between March 15 and July 20, 2023.

Our survey consisted of questions regarding the following characteristics: respondent age, marriage status, presence of children, presence of chronic illnesses, medication history, presence of a family doctor, status of having medical insurance, status of having cancer insurance, habits of smoking and alcohol drinking, health awareness, cancer preventative behaviors, cancer screening history and reasons for receiving cancer screening.

Statistical analysis

Fisher's exact test, $\chi 2$ test, and residual analysis were used for comparisons between employees and female spouses and comparisons by age (20–39 vs. 40 and over) for each question. A p-value of <0.05 was considered to be significant. Factors correlated with more frequently receiving cervical and breast cancer screenings than once every two years were analyzed by both univariate and multivariate logistic regression analysis.

Ethics statement

This study was approved by the Ethics Committee of the Osaka University Hospital (Approval number: 14361). This study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines for cross-sectional studies. All methods were performed in accordance with relevant guidelines and regulations.

- Informed Consent. Informed consent was obtained from all the participants.
- Registry and the Registration No. of the study/trial. N/A.
- Animal Studies. N/A.

Results

Respondent characteristics

A questionnaire-based survey was conducted to clarify the status of receiving cervical and breast cancer population-based screening, occupational health checkups, insured medical care, and personal medical checkups among female employees and male employee's spouses of Sunstar, Inc. The response rate among spouses was unknown because the number of male employees who have spouses could not be determined. Responses were received from 277 employees and 68 spouses (Table 1). The number of female respondents in their 20s was significantly higher among employees (18.0% (50/277)) than among spouses (7.4% (5/68)) ($p<0.05$). Female employees were significantly more likely to be childless than the spouses of employees (58.5% (162/277), 17.7% (12/68), $p<0.05$).

Regarding having a family doctor, female employees were significantly more likely to have one than did the spouses (65.7% (182/277) vs. 50.0% (34/68), $p<0.05$); in particular, female employees were more likely to have a family doctor in the fields of dentistry (41.5% (115/277) vs. 23.5% (16/68), $p<0.05$) and gynecology (25.3% (70/277) vs. 10.3% (7/68), $p<0.05$) (Table 2).

Health awareness and preventive behavior

Most female employees and spouses were concerned about periodontal disease, tooth decay, and cancer, regardless of age (**Supplementary Table 1(a)**). Most female employees and wives, regardless of age, considered dental and cancer screening effective for health care and cancer prevention. The percentages of female employees and spouses taking health-related actions, such as managing their diet, exercise, or walking, were generally around half in all age groups. The percentage of female employees aged 40 and over who received dental checkups for health care was significantly higher (82.6% (147/178)) than for similarly aged spouses (30.9% (17/55)) ($p<0.05$).

Status of receiving cancer screening and reasons for receiving cancer screening

The percentage of male employee's spouses aged 40 and over who receive cancer screening was significantly higher (54.5% (30/55)) than among the female employees aged 20–39 (18.2% (18/99)) ($p<0.05$) (**Supplementary Table 1(b)**).

Cervical cancer screening, targeted at females aged 20 and over in Japan, was received by a significantly higher percentage of female employees in their 20s and 30s (96.2% (76/79)). We found that a small number of female employees in their 20s and 30s and the spouses of male employees had received screening for stomach, colorectal, lung, and breast cancer, which are usually targeted only at those aged 40 and over. In particular, 36.7% (29/79) of female employees in their 20s and 30s had received breast cancer screening, as had 54.6% (6/11) of male employee's spouses in their 20s and 30s.

The percentage of female employees in their 20s and 30s motivated to receive a screening because of receiving pro-screening information at their employment location was significantly higher (68.4% (54/79)). The percentage of respondents who took cancer screening for their health care was significantly higher among those in their 20s and 30s than among those in their 40 and over (80.0% (72/90), 66.8% (147/220), $p<0.05$). The percentage of female employees 40 and over who would be more likely to be willing to receive cancer screening if they could receive cancer screening on weekends and holidays was significantly higher (42.9% (42/98), $p<0.05$). On the other hand, significantly more female employees in their 20s and 30s were willing to receive cancer screening if they could receive it during work hours (48.5% (32/68), $p<0.05$).

Details of the status and frequency of receiving cervical cancer screening

Among female employees in their 20s and 30s, for whom the frequency of screening was known, 78.1% (32/41) were receiving cervical cancer screening significantly more frequently than every two years ($p<0.05$) (Table 3).

	Female employees ($n=277$)		Male employee's spouse ($n=68$)		Total ($n=345$)	
	n	%	n	%	n	%
Age						
20–29	50*	18.0	5**	7.4	55	15.9
30–39	49	17.7	8	11.7	57	16.5
40–49	70	25.3	22	32.4	92	26.7
50–59	96	34.7	27	39.7	123	35.7
60 or over	12	4.3	6	8.8	18	5.2
Marriage status						
Unmarried	117	42.2	-	-	-	-
Married	160	57.8	-	-	-	-
Presence of children						
Don't have	162*	58.5	12**	17.7	174	50.4
Have	115**	41.5	56*	82.3	171	49.6
Presence of chronic illness						
Don't have	92	33.2	23	33.8	115	33.3
Have	185	66.8	45	66.2	230	66.7
Medication history of taking pill						
Don't have	206	74.4	57	83.8	263	76.2
Have	71	25.6	11	16.2	82	23.8
Presence of family doctor						
Don't have	95**	34.3	34*	50.0	129	37.4
Have	182*	65.7	34**	50.0	216	62.6
Status of joining medical insurance						
I have insurance for my dependents	6**	2.2	20*	29.4	26	7.5
I have my own insurance	251*	90.6	41**	60.3	292	84.6
Don't know	20	7.2	7	10.3	27	7.8
Status of joining cancer insurance						
Yes	154	55.6	38	55.9	192	55.7
No	109	39.4	28	41.2	137	39.7
Don't know	14	5.0	2	2.9	16	4.6
Cancer screening						
Have been examined before	245	88.5	65	95.6	310	89.8
Never examined before / Don't know	32	11.5	3	4.4	35	10.2
Smoking						
Smoke daily / Occasional smoker	2	0.7	0	0.0	2	0.6
Used to smoke but not anymore	30	10.8	2	2.9	32	9.3
Never smoked	245	88.5	66	97.1	311	90.1
Alcohol drinking habit						
Drink daily / Occasional drinker	205*	74.0	39**	57.3	244	70.7
Not in the habit of drinking	72**	26.0	29*	42.7	101	29.3

Table 1. Respondent characteristics. *Significantly more, **significantly less, <0.05, chi-square test and residual analysis. Only valid responses were included in the analysis.

On the other hand, the percentage among male employee's spouses aged 40 and over tended to be significantly lower, at 60.9% (14/23, $p<0.05$).

Among female employees in their 20s and 30s who receive cervical cancer screening more frequently than every two years, the percentage of women who receive only one type of screening system (types A-D) was large, at 70.0% (23/30), and the percentage of those who receive occupational health checkups (B) was the largest, at 30.0% (9/30) (Table 4). Among the female employees classified as B or E, the percentage of those in their 20s and 30s who had received an occupational health checkup was 46.7% (14/30).

Among the respondents who received cervical cancer screening every two years, the percentage of those who received only population-based screening every two years tended to be high. Among the respondents who received cervical cancer screening less frequently than every two years, there was no trend in the cancer screening system they used, but a certain proportion of the respondents received cervical cancer screening by an occupational health checkup.

	Female employees (*n* = 277)		Male employee's spouse (*n* = 68)		*p*-value	Total (*n* = 345)	
	n	%	n	%		n	%
Presence of chronic illness							
Periodontal disease							
Yes	24	8.7	4	5.9	0.62	28	8.1
No	253	91.3	64	94.1		317	91.9
Tooth decay							
Yes	21	7.6	4	5.9	0.79	25	7.3
No	256	92.4	64	94.1		320	92.7
Menstrual cramps, irregular periods, premenstrual syndrome							
Yes	53	19.1	8	11.8	0.21	61	17.7
No	224	80.9	60	88.2		284	82.3
Uterine or ovarian disease*							
Yes	33	11.9	9	13.2	0.83	42	12.2
No	244	88.1	59	86.8		303	87.8
Presence of family doctor							
Internal medicine							
Yes	103	37.2	22	32.4	0.48	125	36.2
No	174	62.8	46	67.7		220	63.8
Dentistry							
Yes	115	41.5	16	23.5	0.006	131	38.0
No	162	58.5	52	76.5		214	62.0
Gynecology							
Yes	70	25.3	7	10.3	0.008	77	22.3
No	207	74.7	61	89.7		268	77.7
Other Medical Departments							
Yes	103	37.2	16	23.5	0.034	119	34.5
No	174	62.8	52	76.5		226	65.5

Table 2. Details of responses on presence of chronic illness and family doctor. * Uterine fibroids, endometriosis, ovarian cysts. Fisher's exact test (Extended). Only valid responses were included in the analysis.

The percentage of respondents who received a detailed examination among those found to have abnormalities in the screening process was generally high, at around 90% for all ages (Table 3).

Details of the status of receiving breast cancer screening and details of the status of receiving breast cancer screening by frequency

Although breast cancer screening is targeted to females aged 40 and over, among the respondents in their 20s and 30s, 30.9% (33/107) had received breast cancer screening. Especially among the female employees in their 20s and 30s, for whom the frequency of receiving breast cancer screening was known, 71.4% (5/7) were receiving breast cancer screening more frequently than every two years (Table 5). Among the respondents who receive breast cancer screening more frequently than every two years, the proportion of those in their 20s and 30s who received occupational health checkups, including one screening system or a combination of multiple systems of cancer screening, was relatively high, at 66.7% (4/6) and 42.5% (17/40) in their 40s and above (Table 6).

Among respondents who received breast cancer screening every two years, the proportion of those who received breast cancer screening every two years only by population-based screening or by occupational health checkups tended to be high, with 31.6% (6/19) and 42.1% (8/19) of respondents in their 40s and over, respectively. Among the respondents who were receiving breast cancer screenings less frequently than every two years, the type of cancer screening system varied, but a certain proportion of the respondents used occupational health checkups. The percentage of respondents who received a detailed examination among those found to have abnormalities during screening was generally high, at around 80–90% for all ages (Tables 5 and 6).

Analysis of factors correlated with receiving cervical or breast cancer screening more frequently than once every two years

Analysis of factors that correlated with receiving more frequent cervical cancer screening than the recommended every two years revealed no significant factors in univariate analysis but not by multivariate analysis; the presence or absence of a family doctor was independently correlated (adjusted OR 3.69, 95%CI: 1.06–12.84, $p = 0.04$) (Table 7). This may have been caused by family doctors recommending annual rather than biannual screening. In contrast, no significant factors were detected when the factors correlated with receiving more frequent breast cancer screening were analyzed (Table 8).

	Female employees ($n=277$)		Male employee's spouse ($n=68$)		Total ($n=345$)	
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
	20–39 years old ($n=99$)	Over 40 years old ($n=178$)	20–39 years old ($n=13$)	Over 40 years old ($n=55$)	20–39 years old ($n=122$)	Over 40 years old ($n=233$)
Are you concerned about periodontal disease and tooth decay?						
Yes	87 (87.9)	160 (89.9)	10 (76.9)	50 (90.9)	97 (86.6)	210 (90.1)
No	12 (12.1)	18 (10.1)	3 (23.1)	5 (9.1)	15 (13.4)	23 (9.9)
Are you concerned about cancer?						
Yes	82 (82.8)	155 (87.1)	9 (69.2)	46 (83.6)	91 (81.3)	201 (86.3)
No	17 (17.2)	23 (12.9)	4 (30.8)	9 (16.4)	21 (18.7)	32 (13.7)
Are you managing your diet for health care?						
Yes	49 (49.5)	92 (51.7)	7 (53.8)	35 (63.6)	56 (50.0)	127 (54.5)
Not either	27 (27.3)	48 (27.0)	4 (30.8)	6 (10.9)	31 (27.7)	54 (23.2)
No	23 (23.2)	38 (21.3)	2 (15.4)	14 (25.5)	25 (22.3)	52 (22.3)
Do you exercise or walk for health care?						
Yes	43 (43.4)	84 (47.2)	2 (15.4)	27 (49.1)	45 (40.2)	111 (47.7)
Not either	16 (16.2)	25 (14.0)	3 (23.1)	9 (16.4)	19 (16.9)	34 (14.6)
No	40 (40.4)	69 (38.8)	8 (61.5)	19 (34.5)	48 (42.9)	88 (37.7)
Are you receiving dental checkups for health care?						
Yes	79 (79.8)	147 (82.6)*	9 (69.2)	35 (63.6)**	88 (78.6)	182 (78.1)
Not either	5 (5.1)	10 (5.6)	0 (0.0)	3 (5.5)	5 (4.4)	13 (5.6)
No	15 (15.1)	21 (11.8)**	4 (30.8)	17 (30.9)*	19 (17.0)	38 (16.3)
Do you think dental checkups are effective in preventing periodontal disease and tooth decay?						
Yes	98 (99.0)	171 (96.1)	13 (100.0)	55 (100.0)	111 (99.1)	226 (97.0)
Not either	1 (1.0)	7 (3.9)	0 (0.0)	0 (0.0)	1 (0.9)	7 (3.0)
No	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Do you think cancer screening are effective in preventing cancer?						
Yes	95 (96.0)	153 (85.9)	11 (84.6)	50 (90.9)	106 (94.6)	203 (87.1)
Not either	3 (3.0)	21 (11.8)	2 (15.4)	4 (7.3)	5 (4.5)	25 (10.7)
No	1 (1.0)	4 (2.3)	0 (0.0)	1 (1.8)	1 (0.9)	5 (2.2)

Table 3. Health awareness and preventive behavior. *Significantly more, **significantly less, <0.05, chi-square test and residual analysis. Only valid responses were included in the analysis.

Total number and breakdown of cancer screening

Tables 9 and 10 shows the proportion of each type of cancer screening system in the total number of cervical and breast cancer screenings received. The greatest number of both cervical and breast cancer screenings were conducted during occupational health checkups (Table 11). The proportion of receiving cervical cancer screening by insured medical care was significantly higher ($p<0.05$). The proportion of receiving breast cancer screening by personal medical checkup was also significantly higher ($p<0.05$).

Discussion

In our study, the proportion of female employees in their 20s and 30s who received cancer screening of any kind regularly was significantly lower (31.3%) but the proportion who had received cervical cancer screening was significantly higher (96.2%), indicating a high awareness of the importance of cervical cancer screening, but it is also the only screening covered by insurance or subsidy for that age group (**Supplementary Table 1(b)**). The significantly most frequent reason for receiving cervical cancer screening was because of pro-screening information received from their employer, suggesting that the company providing pro-screening information had been appropriately effective. On the other hand, a lower proportion of the male employees' spouses in their 20s and 30s were compelled by information provided by their spouses' employer, highlighting the challenges of providing health information secondhand.

The MHLW recommends cervical cancer screening every two years, but the proportion of female employees and male employees' spouses who were receiving cervical cancer screening more frequently than every two years was more than half, regardless of whether they were in their 20–30 s or 40s and older. The proportion was extremely high, particularly among female employees in their 20s and 30s (78.1%) (Table 3). Among those who received cervical cancer screening more frequently than every two years, for example, among female employees in their 20s and 30s, the proportion of those who received all their screening at occupational health check-ups was 30.0%, and when screening systems and occupational health check-ups were included, the total proportion of those who received screening more frequently than every two years was 46.7%, or about half of the respondents (Table 4). It was suggested that this may be due to the benefit of receiving occupational health

	Female employees		Male employee's spouse		Total	
	20–39 years old	Over 40 years old	20–39 years old	Over 40 years old	20–39 years old	Over 40 years old
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Have you had any kind of cancer screening?						
Yes, regularly	31(31.3)**	78 (43.8)	5 (38.5)	30 (54.5)*	36(32.1)**	108(46.3)*
Several times irregularly	32 (32.3)	81 (45.5)*	5 (38.5)	21 (38.2)	37 (33.0)	102 (43.8)
Only once	16 (16.2)*	7 (3.9)**	1 (7.7)	3 (5.5)	17 (15.2)*	10 (4.3)**
Never had a cancer screening	18 (18.2)*	10 (5.7)**	2 (15.3)	1 (1.8)**	20 (17.9)*	11 (4.7)**
I don't remember / Don't know	2 (2.0)	2 (1.1)	0 (0.0)	0 (0.0)	2 (1.8)	2 (0.9)
Respondents who had cancer screening regularly, irregularly, or once ($n = 310$)						
Stomach cancer screening						
Yes	7 (8.9)**	62 (37.4)*	1 (9.1)	21 (38.9)	8 (8.9)**	83 (37.7)*
No	72 (91.1)*	104(62.6)**	10 (90.9)	33 (61.1)	83 (91.1)*	137(62.3)**
Colorectal cancer screening						
Yes	18(22.8)**	91 (54.8)*	2 (18.2)	31 (57.4)	20(22.2)**	122(55.5)*
No	61 (77.2)*	75 (45.2)**	9 (81.8)	23 (42.6)	70 (77.8)*	98(44.5)**
Lung cancer screening						
Yes	2 (2.5)**	15 (9.0)	1 (9.1)	17 (31.5)*	3 (3.3)**	32 (14.6)*
No	77 (97.5)*	151 (91.0)	10 (90.9)	37(68.5)**	87 (96.7)*	188(85.4)**
Breast cancer screening						
Yes	29(36.7)**	147 (88.6)*	6 (54.6)	47 (87.0)*	35(38.9)**	194 (88.2)*
No	50 (63.3)*	19 (11.4)**	5 (45.4)	7 (13.0)**	55 (61.1)*	26 (11.8)**
Cervical cancer screening						
Yes	76 (96.2)*	140(84.3)**	11 (100.0)	45 (83.3)	87 (32.0)*	3 (7.9)**
No	3 (3.8)**	26 (15.7)*	0 (0.0)	9 (16.7)	185(68.0)**	35 (92.1)*
Does the following describe reasons for receiving a cancer screening?						
Received a notice from the local government in which you reside.						
Yes	31 (39.2)	88 (53.0)	6 (54.6)	31 (57.4)	37 (41.1)**	119 (54.1)*
No	48 (60.8)	78 (47.0)	5 (45.4)	23 (42.6)	53 (58.9)*	101(45.9)**
Received a notice at information at an employment location						
Yes	54 (68.4)*	100 (60.2)	2 (18.2)**	22(40.7)**	56 (62.2)	122 (55.5)
No	25(31.6)**	66 (39.8)	9 (81.8)*	32 (59.3)*	34 (37.8)	98 (44.5)
Symptoms of concern						
Yes	14 (17.7)	37 (22.3)	1 (9.1)	7 (13.0)	15 (16.7)	44 (20.0)
No	65 (82.3)	129 (77.7)	10 (90.9)	47 (87.0)	75 (83.3)	176 (80.0)
Cancer experience of someone close to you						
Yes	5 (6.3)**	33 (19.9)*	1 (9.1)	9 (16.7)	6 (6.7)**	84 (19.1)*
No	74 (93.7)*	133(80.1)**	10 (90.9)	45 (83.3)	42 (93.3)*	178(80.9)**
Health care for yourself						
Yes	15 (19.0)	55 (33.1)	3 (27.3)	18 (33.3)	18 (20.0)**	73 (33.2)*
No	64 (81.0)	111 (66.9)	8 (72.7)	36 (66.7)	72 (80.0)*	147(66.8)**
Recommendations from a partner						
Yes	1 (1.3)	1 (0.6)**	0 (0.0)	6 (11.1)*	1 (1.1)	7 (3.2)
No	78 (98.7)	165 (99.4)*	11 (100.0)	48(88.9)**	89 (98.9)	213 (96.8)
Recommendations from parents						
Yes	5 (6.3)	5 (3.0)	0 (0.0)	0 (0.0)	5 (5.6)	5 (2.3)
No	74 (93.7)	161 (97.0)	11 (100.0)	54 (100.0)	85 (94.4)	215 (97.7)
Recommendations from a friend						
Yes	0 (0.0)	8 (4.8)	0 (0.0)	1 (1.9)	0 (0.0)	9 (4.1)
No	79 (100.0)	158 (95.2)	11 (100.0)	53 (98.1)	90 (100.0)	211 (95.9)
Recommendations from a family doctor						
Yes	11 (13.9)	17 (10.2)	0 (0.0)	5 (9.3)	11 (12.2)	22 (10.0)
No	68 (86.1)	149 (89.8)	11 (100.0)	49 (90.7)	79 (87.8)	198 (90.0)
Respondents who had cancer screening irregularly, once or never had a cancer screening ($n = 197$)						
Does the following describes reasons to be more willing to receive cancer screenings?						
Free of cost						
Yes	49 (74.2)	59 (60.2)	6 (75.0)	20 (80.0)	55 (74.3)	79 (64.2)
Continued						

	Female employees		Male employee's spouse		Total	
No	17 (25.8)	39 (39.8)	2 (25.0)	5 (20.0)	19 (25.7)	44 (35.8)
Available for cancer screening at work						
Yes	45 (68.2)*	53 (54.1)	2 (25.0)	4 (16.0)**	47 (63.5)*	27 (46.3)**
No	21(31.8)**	45 (45.9)	6 (75.0)	21 (84.0)*	57(36.5)**	66 (53.6)*
Available for cancer screening on weekends and holidays						
Yes	18 (27.3)	42 (42.9)*	3 (37.5)	3 (12.0)**	21 (28.4)	45 (36.6)
No	48 (72.7)	56 (57.1)**	5 (62.5)	22 (88.0)*	53 (71.6)	78 (63.4)
Available for cancer screening at night						
Yes	7 (10.6)	16 (16.3)*	0 (0.0)	0 (0.0)	7 (9.5)	16 (13.0)
No	59 (89.4)	82 (83.7)**	8 (100.0)	25 (100.0)	67 (90.5)	107 (87.0)
Available for cancer screening at a convenient location						
Yes	40 (60.6)	55 (56,1)	7 (87.5)	16 (64.0)	47 (64.5)	71 (57.7)
No	26 (39.4)	43 (43.9)	1 (12.5)	9 (36.0)	27 (36.5)	52 (42.3)
Available for cancer screening during work hours						
Yes	32 (48.5)*	40 (40.8)	1 (12.5)	1 (4.0)**	33 (44.6)	41 (33.3)
No	34(51.5)**	58 (59.2)	7 (87.5)	24 (96.0)*	41 (55.4)	82 (66.7)
Strong recommendation by someone						
Yes	9 (13.6)*	1 (1.0)**	1 (12.5)	0 (0.0)	10 (13.5)*	1 (0.8)**
No	57(86.4)**	97 (99.0)*	7 (87.5)	25 (100.0)	64 (86.5)**	122 (99.2)*
Easy to make an appointment						
Yes	29 (43.9)	37 (37.8)	3 (37.5)	14 (56.0)	32 (43.2)	51 (41,5)
No	37 (56.1)	61 (62.2)	5 (62.5)	11 (44.0)	42 (56.8)	72 (58.5)
Available to receive a cancer screening with child						
Yes	8 (12.2)	3 (3.1)**	2 (25.0)*	1 (4.0)	10 (13.5)*	4 (3.3)**
No	58 (87.8)	95 (96.9)*	6 (75.0)**	24 (96.0)	64 (86.5)**	119 (96.7)*
Short waiting time						
Yes	21 (31.8)	31 (31.6)	3 (37.5)	4 (16.0)	24 (32.4)	35 (28.5)
No	45 (68.2)	67 (68.4)	5 (62.5)	21 (84.0)	50 (67.6)	88 (71.5)

Table 4. Status of receiving cancer screening and reasons for receiving cancer screening. *Significantly more, **significantly less, < 0.05, chi-square test and residual analysis. Only valid responses were included in the analysis.

check-ups stimulated by receiving a notice from the employer, but that scenario is also causing the intervals between screenings to be shorter than recommended for some women.

Although the invasiveness of cervical cancer screening is negligible, screening more frequently than recommended only marginally reduces the number of missed cases. This point raises the question of whether the cost and minimal bother are worth the minuscule protection benefit accrued. Unnecessary screening increases the likelihood of false positives and results in additional testing for a disease that may resolve spontaneously. False positives are a physical and emotional burden for patients, and an economic burden for patients and employers.

Among the respondents who received cancer screening every two years, more than half of the respondents, regardless of whether they were female employees or employees' spouses and whether they were in their 20s and 30s or their 40s or older, were more likely to receive cancer screening at population-based screening (Table 3). This suggests that population-based screening is taking place for cervical cancer screening at appropriate intervals and that it is the occupational health checkups that are causing the higher frequency of cancer screening than the recommended every two years. From this perspective, we can't recommend additional cervical cancer screening by occupational health checkups. It is currently more appropriate to recommend cervical cancer screening be conducted by population-based screening. However, among the respondents who received cancer screening less frequently than every two years, a certain proportion of these were conducted during occupational health checkups, so there is a reasonable concern that losing cervical cancer screening by occupational health checkups could result in a complete loss of the opportunity to receive cancer screening for a small group of individuals.

The most realistic suggestions for screening opportunities could include the following. First, accurate records of cervical cancer screening status and the screening system used should be kept and monitored. Women who received screenings more frequently than every two years by combined occupational health checkups and population-based screening should be educated to receive screenings only every two years, predominantly by population-based screening. Finally, those eligible for screening who received it less frequently than every two years should be educated to seek free screening during their occupational health checkups, and the occupational clinics should be informed or have records of the last screening.

Testing for HPV infection will soon be a part of routine cervical cancer screening[28]. It will be recommended that HPV-negative cases receive cervical screening only every five years instead of two. We will recommend

	Female employees		Male employee's spouse		Total	
	20–39 years old	Over 40 years old	20–39 years old	Over 40 years old	20–39 years old	Over 40 years old
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Have you had a cervical cancer screening?						
Yes, regularly	34 (35.1)	65 (37.8)	6 (50.0)	30 (56.6)	40 (36.7)	95 (42.2)
Several times irregularly	27 (27.8)	63 (36.6)	4 (33.4)	10 (18.9)	31 (28.4)	73 (32.4)
Only once	19 (19.6)	22 (12.8)	1 (8.3)	6 (11.3)	20 (18.4)	28 (12.5)
Never had a cancer screening	17 (17.5)	22 (12.8)	1 (8.3)	7 (13.2)	18 (16.5)	29 (12.9)
Respondents who had cancer screening regularly, irregularly, or once						
Were there any abnormalities found at cervical cancer screening?						
Yes	16 (20.0)	27 (18.5)	1 (9.1)	8 (17.4)	17 (32.7)	35 (32.0)
No	64 (80.0)	119 (81.5)	10 (90.9)	38 (82.6)	74 (67.3)	157 (68.0)
Respondents who were found to the abnormalities in the screening						
Have you received a detailed examination?						
Yes	14 (87.5)	26 (96.3)	1 (100.0)	7 (87.5)	15 (88.2)	33 (94.3)
No	2 (12.5)	1 (3.7)	0 (0.0)	1 (12.5)	2 (11.8)	2 (5.7)
Respondents who had cancer screening regularly or irregularly						
Frequency of receiving cervical cancer screening						
More frequently than every two years	32 (78.1)	41 (63.0)	2 (40.0)	14 (60.9)	34 (73.9)	55 (62.5)
Every two years	3 (7.3)	12 (18.5)	1 (20.0)	4 (17.4)	4 (8.7)	16 (18.2)
Less frequently than every two years	6 (14.6)	12 (18.5)	2 (40.0)	5 (21.7)	8 (17.4)	17 (19.3)

Table 5. Details of status of receiving cervical cancer screening. * Significantly more, ** significantly less, < 0.05, chi-square test and residual analysis. Only valid responses were included in the analysis.

that the HPV-positive but cytologically normal cases receive follow-up cervical screening one year later. This will complicate the screening process and will require a detailed monitoring of the status of everyone's HPV and cervical screening results. We should take this opportunity to develop a nationwide system for accurately collecting and sharing the status of cervical-related medical examinations among health professionals for all screening-eligible women.

For breast cancer screening in Japan, the targeted age group is 40 years and over, but there were 30.8% (33/107) of the respondents in their 20s and 30s who had already received breast cancer screening (Table 5). In particular, among respondents in their 20s and 30s, 66.7% (4/6) of those who received screening more frequently than every two years received screening either only by occupational health checkups or in combination with another cancer screening system and screening by occupational health checkups (Table 6). Without evidence of predisposition for breast cancer, this constitutes excessive or inappropriate screening from the point of view of radiation exposure and the risk of false positives.

One factor that correlated with excessive cervical cancer screening was having a family doctor (Table 7). A certain proportion of cervical cancer screening (28.2%) was provided by gynecologists and insured medical care (Tables 9 and 10). Gynecologists responsible for screening should be educated to better understand the appropriate intervals for screening and not be influenced by financial interests.

In conclusion, our survey revealed that cervical and breast cancer screening for a corporate entity was being performed with inappropriate frequency through their provided occupational health checkups. Proper guidance to women and their screening providers should be given on appropriate screening record-keeping and screening intervals.

Study limitations

The strength of this study is that it provides a detailed description of the status and frequency of cervical and breast cancer screening and their overuse in some cases. On the other hand, as it is a questionnaire survey, biased misremembering cannot be ruled out. There is also a possibility that many of the responses came from women with a higher-than-normal level of health awareness. In addition, the number of responses from male employees' spouses was less than optimal, so there is a concern that comparisons between employees and employee spouses were not made fairly. Importantly, this study was conducted within a single company, so a large-scale study of other companies, of different sizes and other industries, would be needed to generalize the results.

	Female employees		Male employee's spouse		Total	
	20–39 years old	Over 40 years old	20–39 years old	Over 40 years old	20–39 years old	Over 40 years old
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
More frequently than every two years						
Which cancer screening system was used to conduct the cervical cancer screening that you received?						
A	4 (13.3)	3 (7.5)	0 (0.0)	0 (0.0)	4 (12.5)	3 (5.6)
B	9 (30.0)	15 (37.5)	0 (0.0)	5 (35.7)	9 (28.1)	20 (37.0)
C	8 (26.7)	5 (12.5)	0 (0.0)	1 (7.1)	8 (25.0)	6 (11.1)
D	2 (6.7)	2 (5.0)	0 (0.0)	2 (14.3)	2 (6.3)	4 (7.4)
E	7 (23.3)	15 (37.5)	2 (100.0)	6 (42.9)	9 (28.1)	21 (38.9)
Did the cancer screenings you received include cancer screenings conducted as occupational health checkups?						
Yes	14 (46.7)	20 (50.0)	2 (100.0)	9 (64.3)	16 (50.0)	29 (53.7)
No	16 (53.3)	20 (50.0)	0 (0.0)	5 (35.7)	16 (50.0)	25 (46.3)
Every two years						
Which cancer screening system was used to conduct the cervical cancer screening that you received?						
A	2 (66.7)	7 (58.3)	1 (100.0)	1 (33.3)	3 (75.0)	8 (53.3)
B	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
C	0 (0.0)	3 (25.0)	0 (0.0)	1 (33.3)	0 (0.0)	4 (26.7)
D	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
E	1 (33.3)	2 (16.7)	0 (0.0)	1 (33.3)	1 (25.0)	3 (20.0)
Did the cancer screenings you received include cancer screenings conducted as occupational health checkups?						
Yes	0 (0.0)	1 (8.3)	0 (0.0)	1 (33.3)	0 (0.0)	2 (13.3)
No	31 (100.0)	11 (91.7)	1 (100.0)	2 (66.7)	4 (100.0)	13 (86.7)
Less frequently than every two years						
Which cancer screening system was used to conduct the cervical cancer screening that you received?						
A	0 (0.0)	2 (16.7)	0 (0.0)	0 (0.0)	0 (0.0)	2 (11.8)
B	1 (16.7)	2 (16.7)	0 (0.0)	3 (60.0)	1 (12.5)	5 (29.4)
C	1 (16.7)	3 (24.0)	0 (0.0)	0 (0.0)	1 (12.5)	3 (17.7)
D	0 (0.0)	1 (8.3)	0 (0.0)	1 (20.0)	0 (0.0)	2 (11.7)
E	4 (66.6)	4 (33.3)	2 (100.0)	1 (20.0)	6 (75.0)	5 (29.4)
Did the cancer screenings you received include cancer screenings conducted as a service by National Health Insurance Association (Opportunistic screening)?						
Yes	1 (16.7)	3 (25.0)	1 (50.0)	4 (80.0)	2 (25.0)	7 (41.2)
No	5 (83.3)	9 (75.0)	1 (50.0)	1 (20.0)	6 (75.0)	10 (58.8)

Table 6. Details of status of receiving cervical cancer screening by frequency. Only valid responses were included in the analysis. (A) All the cancer screenings that were received were screenings that were conducted as a residents' screening by local governments (Population-based screening). (B) All the cancer screenings that were received were screenings that were conducted as an occupational health checkup provided by a company's health insurance association for welfare purposes (Occupational health checkups). (C) All the cancer screenings that were received were screenings that were conducted as a part of examination using an insured medical care regulated by the government (Insured medical care). (D) All the cancer screenings that were received were screenings that were conducted as a personal medical checkup fully reimbursed by the examinee (Personal medical checkup). (E) Cancer screenings received were either A to D at each examination (did not consistently receive cancer screening by the same cancer screening system).

	Female employees		Male employee's spouse		Total	
	20–39 years old	Over 40 years old	20–39 years old	Over 40 years old	20–39 years old	Over 40 years old
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Have you had a cervical cancer screening?						
Yes, regularly	7 (7.3)**	55 (31.1)	4 (36.3)	27 (50.0)*	11 (10.3)**	82 (35.5)*
Several times irregularly	5 (5.2)**	78 (44.1)*	0 (0.0)**	15 (27.8)	5 (4.7)**	93 (40.3)*
Only once	15 (15.6)	26 (14.7)	2 (18.2)	7 (13.0)	17 (15.9)	33 (14.3)
Never had a cancer screening	69 (71.9)*	18 (10.1)**	5 (45.5)	5 (9.2)**	74 (69.1)*	23 (9.9)**
Respondents who had cancer screening regularly, irregularly, or once						
Were there any abnormalities found at cervical cancer screening?						
Yes	4 (15.4)	30 (19.1)	1 (16.7)	11 (22.4)	5 (15.6)	41 (19.9)
No	22 (84.6)	127 (80.9)	5 (83.3)	38 (77.6)	27 (84.4)	165 (80.1)
Respondents who were found to have abnormalities in the screening						
Have you received a follow up detailed examination?						
Yes	3 (75.0)	28 (93.3)	1 (100.0)	9 (81.8)	4 (80.0)	37 (90.2)
No	1 (25.0)	2 (6.7)	0 (0.0)	2 (18.2)	1 (20.0)	4 (9.8)
Respondents who had cancer screening regularly or irregularly						
Frequency of receiving cervical cancer screening						
More frequently than every two years	5 (71.4)	23 (46.9)	1 (100.0)	18 (66.7)	6 (75.0)	41 (54.0)
Every two years	0 (0.0)	17 (34.7)	0 (0.0)	3 (11.1)	0 (0.0)	20 (26.3)
Less frequently than every two years	2 (28.6)	9 (18.4)	0 (0.0)	6 (22.2)	2 (25.0)	15 (19.7)

Table 7. Details of status of receiving breast cancer screening. * Significantly more, ** significantly less, < 0.05, chi-square test and residual analysis. Only valid responses were included in the analysis.

	Female employees		Male employee's spouse		Total	
	20–39 years old	Over 40 years old	20–39 years old	Over 40 years old	20–39 years old	Over 40 years old
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
More frequently than every two years						
Which cancer screening system was used to conduct the cervical cancer screening that you received?						
A	0 (0.0)	2 (9.1)	0 (0.0)	0 (0.0)	0 (0.0)	2 (5.0)
B	2 (40.0)	2 (9.1)	1 (100.0)	8 (44.5)	3 (50.0)	10 (25.0)
C	0 (0.0)	3 (13.7)	0 (0.0)	2 (11.1)	0 (0.0)	5 (12.5)
D	1 (20.0)	4 (18.2)	0 (0.0)	2 (11.1)	1 (16.7)	6 (15.0)
E	2 (40.0)	11 (50.0)	0 (0.0)	6 33.3)	2 (33.3)	17 (42.5)
Did the cancer screenings you received include cancer screenings conducted as a service by the National Health Insurance Association (Opportunistic screening)?						
Yes	3 (60.0)	6 (27.3)	1 (100.0)	11 (61.1)	4 (66.7)	17 (42.5)
No	2 (40.0)	16 (72.3)	0 (0.0)	7 (38.9)	2 (33.3)	23 (57.5)
Every two years						
Which cancer screening system was used to conduct the cervical cancer screening that you received?						
A	0 (0.0)	5 (29.4)	0 (0.0)	1 (50.0)	0 (0.0)	6 (31.6)
B	0 (0.0)	7 (41.2)	0 (0.0)	1 (50.0)	0 (0.0)	8 (42.1)
C	0 (0.0)	1 (5.9)	0 (0.0)	0 (0.0)	0 (0.0)	1 (5.3)
D	0 (0.0)	1 (5.9)	0 (0.0)	0 (0.0)	0 (0.0)	1 (5.3)
E	0 (0.0)	31 (17.6)	0 (0.0)	0 (0.0)	0 (0.0)	3 (15.7)
Did the cancer screenings you received include cancer screenings conducted as a service by the National Health Insurance Association (Opportunistic screening)?						
Yes	0 (0.0)	7 (41.2)	0 (0.0)	1 (50.0)	0 (0.0)	8 (42.1)
No	0 (0.0)	10 (58.8)	0 (0.0)	1 (50.0)	0 (0.0)	11 (57.9)
Less frequently than every two years						
Which cancer screening system was used to conduct the cervical cancer screening that you received?						
A	0 (0.0)	3 (33.3)	0 (0.0)	4 (66.7)	0 (0.0)	7 (46.7)
B	0 (0.0)	3 (33.3)	0 (0.0)	2 (33.3)	0 (0.0)	5 (33.3)
C	0 (0.0)	2 (22.3)	0 (0.0)	0 (0.0)	0 (0.0)	2 (13.3)
D	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
E	2 (100.0)	1 (11.1)	0 (0.0)	0 (0.0)	2 (100.0)	1 (6.7)
Did the cancer screenings you received include cancer screenings conducted as a service by the National Health Insurance Association (Opportunistic screening)?						
Yes	2 (100.0)	4 (44.4)	0 (0.0)	2 (33.3)	2 (100.0)	6 (40.0)
No	0 (0.0)	5 (55.6)	0 (0.0)	4 (66.7)	0 (0.0)	9 (60.0)

Table 8. Details of status of receiving breast cancer screening by frequency. Only valid responses were included in the analysis. (A) All the cancer screenings that were received were screenings that were conducted as a residents' screening by local governments (Population-based screening). (B) All the cancer screenings that were received were screenings conducted as an occupational health checkup provided by a company's health insurance association for welfare purposes (Occupational health checkups). (C) All the cancer screenings that were received were screenings that were conducted as a part of examination using an insured medical care regulated by the government (Insured medical care). (D) All the cancer screenings that were received were screenings that were conducted as a personal medical checkup fully reimbursed by the examinee (Personal medical checkup). (E) Cancer screenings received were either A to D at each examination (not consistently receive cancer screening by the same cancer screening system).

Characteristic	Comparison	*n*	Unadjusted OR (95%CI)	*p*-value	Adjusted OR (95%CI)	*p*-value
Group	Male employee's spouse	21	Reference		Reference	
	Female employees	88	1.52 (0.48–4.79)	0.47	1.08 (0.26–4.42)	0.91
Age	20–39 years old	38	Reference		Reference	
	Over 40 years old	71	0.40 (0.12–1.31)	0.13	0.48 (0.12–1.90)	0.30
Marriage status	Unmarried	25	Reference		Reference	
	Married	84	0.81 (0.24–2.69)	0.73	1.36 (0.26–7.19)	0.72
Presence of children	Don't have	58	Reference		Reference	
	Have	51	1.82 (0.66–4.98)	0.25	1.82 (0.45–7.34)	0.40
Presence of chronic illness	Don't have	28	Reference		Reference	
	Have	81	0.68 (0.21–2.23)	0.52	0.40 (0.10–1.62)	0.20
Medication history of taking pill	Don't have	82	Reference		Reference	
	Have	27	7.84 (0.997–61.65)	0.050	6.99 (0.80–60.71)	0.08
Presence of family doctor	Don't have	36	Reference		Reference	
	Have	73	2.42 (0.90–6.51)	0.079	3.69 (1.06–12.84)	0.040
Status of joining cancer insurance	No / Don't know	47	Reference		Reference	
	Yes	62	1.10 (0.41–2.91)	0.85	0.95 (0.31–2.95)	0.93
Are you concerned about cancer?	No	14	Reference		Reference	
	Yes	995	0.71 (0.15–3.47)	0.68	0.56 (0.10–3.17)	0.51
Do you think cancer screening is effective in preventing cancer?	No / Not either	8	Reference		Reference	
	Yes	101	1.54 (0.29–8.24)	0.62	2.10 (0.31–14.18)	0.45

Table 9. Analysis of factors correlated with more frequently receiving cervical cancer screening than once every two years.

Characteristic	Comparison	*n*	Unadjusted OR (95%CI)	*p*-value	Adjusted OR (95%CI)	*p*-value
Group	Male employee's spouse	22	Reference		Reference	
	Female employees	46	0.27 (0.07–1.05)	0.06	0.15 (0.02–1.14)	0.07
Age	20–39 years old	7	Reference		Reference	
	Over 40 years old	61	Omitted*	Omitted*	Omitted	Omitted*
Marriage status	Unmarried	17	Reference		Reference	
	Married	51	4.09 (1.28–13.09)	0.018	4.71 (0.83–26.83)	0.08
Presence of children	Don't have	37	Reference		Reference	
	Have	31	0.44 (0.15–1.27)	0.13	2.27 (0.38–13.52)	0.37
Presence of chronic illness	Don't have	21	Reference		Reference	
	Have	47	0.67 (0.21–2.16)	0.5	0.59 (0.14–2.49)	0.47
Medication history of taking pill	Don't have	56	Reference		Reference	
	Have	12	2.37 (0.47–11.95)	0.30	1.90 (0.28–12.92)	0.51
Presence of family doctor	Don't have	22	Reference		Reference	
	Have	46	2.20 (0.74–6.53)	0.15	2.71 (0.57–12.85)	0.21
Status of joining cancer insurance	No / Don't know	22	Reference		Reference	
	Yes	46	1.18 (0.39–3.57)	0.76	1.37 (0.32–5.79)	0.67
Are you concerned about cancer?	No	5	Reference		Reference	
	Yes	63	1.67 (0.26–10.82)	0.59	4.63 (0.28–75.40)	0.28
Do you think cancer screening is effective in preventing cancer?	No / Not either	6	Reference		Reference	
	Yes	62	1.22 (0.21–7.27)	0.83	1.44 (0.18–11.57)	0.73

Table 10. Analysis of factors correlated with more frequently receiving breast cancer screening than once every two years. *There were 0 women aged 20–39 years in the group who had been received breast cancer screening every two years.

	Cervical cancer screening (*n* = 745)	Breast cancer screening (*n* = 597)
A	196 (26.3%)	186 (31.2%)
B	274 (36.8%)	231 (38.7%)
C	210* (28.2%)	76** (12.7%)
D	65** (8.7%)	104* (17.4%)

Table 11. Total number and breakdown of cancer screening. (A) Cancer screenings that were conducted as a residents' screening by local governments (Population-based screening). (B) Cancer screenings that were conducted as an occupational health checkup provided by a company's health insurance association for welfare purposes (Occupational health checkups). (C) Cancer screenings that were conducted as a part of examination using an insured medical care regulated by the government (Insured medical care). (D) Cancer screenings that were conducted as a personal medical checkup fully reimbursed by the examinee (Personal medical checkup).

Data availability

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

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Conceptualization: AY, YU, and YT. Data curation: AY. Formal analysis, methodology, visualization, validation: AY, YU, and YT. Resources: KK, RO, NY, SK, and YT. Interpretation of the data: AY, YU, and YT. Writing - original draft: AY and YU. Critically revising the manuscript: KK, RO, NY, SK, and YT. All authors have contributed to the article and have approved this submitted version. The work reported in the paper has been performed by the authors unless specified in the text.

Declarations

Conflict of interest
AY, YU, SI, EO, MK, SN, and KH do not have any competing interests to declare. KK, RO, NY, SK, and YT are employees of Sunstar, Inc.

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