RESEARCH ARTICLE

What is the Most Effective Strategy for Improving the Cancer Screening Rate in Japan?

Hiroshi Sano[1]*, Rei Goto[2], Chisato Hamashima[3]

Abstract

Background: Cancer screening rates in Japan are much lower than those in Western countries. This study evaluated the relationship between cancer screening rates and strategies used to improve screening rates, and determined which strategy is the most effective. Materials and Methods: All municipalities are responsible for conducting gastric, lung, colorectal, cervical, and breast cancer screenings in Japan. Of the 1,746 municipalities in total, 92-99% were included in the analyses for each cancer screening. Using national data in 2009, the correlations between cancer screening rates and strategies for improving screening rates of all municipalities, both large (populations of over 30,000) and small (populations of under 30,000), were determined. The strategies used were as follows: sending personal invitation letters, personal visits by community health workers, use of a clinical setting for screening, and free screening. Results: Of all four strategies used to improve cancer screening rates, sending personal invitation letters had the highest correlations with all screening rates, with the exception of breast cancer screening. The partial correlation coefficients linking this strategy with the screening rates in all municipalities were 0.28, 0.32, 0.30, and 0.26 for gastric, lung, colorectal, and cervical cancer screening, respectively. In large municipalities, the correlations between the number of examinees in a clinical setting and the screening rates were also relatively high, particularly for cervical cancer screening (r=0.41). Conclusions: Sending personal invitation letters appears to be particularly effective in improving cancer screening rates in all municipalities. All municipalities should implement a system that sends personal invitation letters for cancer screening. In large municipalities, increasing the availability of screening in a clinical setting is also effective in improving cancer screening rates.

Keywords: Cancer screening - screening rate - strategy to increase participation- correlation - Japan

Asian Pac J Cancer Prev, **15 (6)**, 2607-2612

Introduction

Since population-based screening for cancer was introduced under the Health and Medical Service Act for the elderly in 1983, municipalities have been responsible for conducting cancer screenings in Japan. Screening programs for five kinds of cancers (gastric, lung, colorectal, cervical, and breast cancers) have become continuously conducted by all municipalities. However, cancer screening rates in Japan are much lower than those in Western countries and Korea, including examinations other than population-based screening that are conducted as part of a public policy to reduce mortality rates. While the screening rates for breast and cervical cancer in 2010 were 80.4% and 85.0%, respectively, in the United States, 70.9% and 67.9% in Korea, and 73.4% and 78.5%, in the United Kingdom, both screening rates were 24.3% in Japan (OECD, 2011; Suh et al., 2013).

To improve cancer screening rates, effective strategies that motivate people to be screened need to be successfully implemented. The U.S. Center for Disease Control and Prevention (CDC) conducted systematic reviews on the effectiveness of various interventions in increasing the screening rates for breast, cervical, and colorectal cancers, and published guidelines based on their findings, which recommend certain interventions for improving the screening rates for these cancers (Baron et al., 2008a; Sabatino et al., 2012; Community Preventive Services Task Force (CPSTF), 2013). The guidelines also aid decision makers in choosing an appropriate intervention (Townsend et al., 2009; Blumenthal et al., 2010; Lobb et al., 2011; Hannon et al., 2012).

In Japan, there are no guidelines on the types of strategies that improve cancer screening rates. Some studies have previously evaluated the effectiveness of various strategies (Hisamichi et al., 1991; Watanabe, 2003; Shimada et al., 2010a; Shimada et al., 2010b; Matsuda et al., 2011; Takaku, 2011; Kuroki, 2012; Yoshida et al., 2012), but it was difficult to compare the effectiveness of these strategies, as each study focused on

*[1]Faculty of Economics, Shiga University, Shiga, [2]The Hakubi Center of Advanced Research, Graduate School of Economics, Kyoto University, Kyoto, [3]Cancer Screening Assessment and Management Division, Research Center for Cancer Prevention and Screening, National Cancer Center, Tokyo, Japan *For correspondence: hi-sano@biwako.shiga-u.ac.jp*

the effectiveness of an individual strategy using different subjects and methodologies. As the most effective strategy in improving cancer screening rates differs depending on the country and region (McAvoy and Raza, 1991; King et al., 1994; Saywell et al., 1999; Champion et al., 2003; Saywell et al., 2003; Saywell et al., 2004; Blumenthal at al., 2010; Lee et al., 2012; Frie et al., 2013), it remains unclear which strategy would be the most effective in Japan. Therefore, a study comparing the effectiveness of different strategies used to improve cancer screening rates in Japan is warranted and poised to be very useful for decision makers.

The aim of the present study was to quantitatively evaluate the relationships between cancer screening rates and strategies used to improve screening rates, as well as to determine which strategy is the most effective in Japan.

Materials and Methods

Subjects

The subjects were selected from a total of 1,746 municipalities that conducted gastric, lung, colorectal, cervical, and breast cancer screening in Japan. Cancer screening rates of municipalities were determined from data in the Report on Regional Public Health Services and Health Promotion Services between April 2009 and March 2010, which was prepared by the Ministry of Health, Labour, and Welfare (MHLW, 2010). In this report, the number of participants and persons eligible for the cancer screenings was tallied by sex and age in 1,746 municipalities. Persons eligible for the cancer screenings conducted by municipalities included women aged ≥20 years for cervical cancer screening, women aged ≥40 years for breast cancer screening, and both men and women aged ≥40 years for other cancer screenings. Using this report, the following characteristics of municipalities were determined: the number of eligible persons, the ratio of males to females, and percentage of those aged ≥65 years.

Data on strategies implemented by each municipality for cancer screening were obtained from a survey on the implementation of cancer screening among the different municipalities, which was conducted by the MHLW in January 2010. In this survey, the MHLW collected data on the content of examinations, strategies, and out-of-pocket costs for cancer screening among the different municipalities. 1,740 of all municipalities (99.7%) had responded to this survey. The CDC recommends interventions that use client reminders and small media, and interventions that include one-on-one education by telephone or via face-to-face encounters for colorectal, cervical, and breast cancer screening (Sabatino et al., 2012). It also recommends interventions that make screening accessible and easier for colorectal and breast cancer, and reduce out-of-pocket costs for breast cancer screening (Baron et al., 2008a; Sabatino et al., 2012; CPSTF, 2013). Based on these recommendations, similar strategies were assessed, in particular: sending personal invitation letters, personal visitations by community health workers, number of individuals screened in a clinical setting, and free screening. The use of newsletters in place of small media was not evaluated because about 90% of municipalities already implemented this strategy.

Table 1. Characteristics of Cancer Screening in Japan between April 2009 and March 2010

Variable	Gastric	Lung	Colorectal	Cervical	Breast
			All municipalities		
Number of municipalities	1,718	1,610	1,726	1,717	1,693
Screening rate(%); mean (S.D.)	15.8 (12.0)	27.4 (18.9)	21.4 (13.6)	16.9 (10.4)	13.2 (10.8)
Strategies					
Sending personal invitation letters; n (%)	946 (55.1)	889 (55.2)	947 (54.9)	966 (56.3)	933 (55.1)
Personal visitations by community health workers; n (%)	105 (6.1)	99 (6.2)	107 (6.2)	104 (6.1)	102 (6.0)
Number of individuals screened in clinical settings; mean (S.D.)	613 (2,891)	1,369 (6,582)	1,947 (6,967)	1,691 (5,091)	759 (2,706)
Free screening; n (%)	143 (8.3)	362 (22.5)	167 (9.7)	161 (9.4)	119 (7.0)
Characteristics of eligible persons					
Number of eligible persons; mean (S.D.)	22,315 (47,190)	22,821 (43,855)	22,946 (49,320)	18,701 (41,438)	13,747 (29,503)
Ratio of males to females; mean (S.D.)	0.73 (0.16)	0.72 (0.17)	0.73 (0.17)	-	-
Percentage of those aged ≥65 years; mean (S.D.)	52.9 (12.1)	53.4 (12.3)	53.0 (12.1)	42.6 (13.0)	53.2 (11.9)
			Large municipalities (population ≥30,000)		
Number of municipalities	809	767	812	808	800
Screening rate(%); mean (S.D.)	12.3 (9.0)	22.1 (15.7)	18.3 (10.9)	15.2 (8.1)	12.2 (8.6)
Strategies					
Sending personal invitation letters; n (%)	407 (50.3)	396 (51.6)	416 (51.2)	422 (52.2)	406 (50.8)
Personal visitations by community health workers; n (%)	24 (3.0)	21 (2.7)	24 (3.0)	22 (2.7)	22 (2.8)
Number of individuals screened in clinical settings; mean (S.D.)	1,255 (4,116)	2,806 (9,326)	4,052 (9,736)	3,455 (7,011)	1,538 (3,786)
Free screening; n (%)	70 (8.7)	162 (21.1)	79 (9.7)	75 (9.3)	45 (5.6)
Characteristics of eligible persons					
Number of eligible persons; mean (S.D.)	42,401 (62,911)	43,018 (57,003)	43,709 (65,937)	36,094 (55,436)	26,134 (39,346)
Ratio of males to females; mean (S.D.)	0.69 (0.17)	0.68 (0.17)	0.69 (0.17)	-	-
Percentage of those aged ≥65 years; mean (S.D.)	52.0 (12.4)	52.3 (12.5)	52.0 (12.4)	39.8 (12.2)	51.5 (11.4)
			Small municipalities (population <30,000)		
Number of municipalities	909	843	914	909	893
Screening rate(%); mean (S.D.)	18.9 (13.4)	32.2 (20.2)	24.1 (15.0)	18.4 (11.9)	14.2 (12.4)
Strategies					
Sending personal invitation letters; n (%)	539 (59.3)	493 (58.5)	531 (58.1)	544 (59.9)	527 (59.0)
Personal visitations by community health workers; n (%)	81 (8.9)	78 (9.3)	83 (9.1)	82 (9.0)	80 (9.0)
Number of individuals screened in clinical settings; mean (S.D.)	41 (175)	62 (263)	78 (285)	122 (228)	62 (127)
Free screening; n (%)	73 (8.0)	200 (23.7)	88 (9.6)	86 (9.5)	74 (8.3)
Characteristics of eligible persons					
Number of eligible persons; mean (S.D.)	4,439 (3,126)	4,445 (3,084)	4,500 (3,124)	3,241 (2,321)	2,650 (1,864)
Ratio of males to females; mean (S.D.)	0.77 (0.15)	0.76 (0.16)	0.77 (0.16)	-	-
Percentage of those aged ≥65 years; mean (S.D.)	53.8 (11.8)	54.5 (12.1)	53.9 (11.8)	45.0 (13.1)	54.8 (12.1)

Municipalities were excluded from the study if there were missing values in these variables or <10 eligible persons. Furthermore, municipalities were also excluded if they did not perform the following examinations: gastric X-ray for gastric cancer, chest X-ray for lung cancer, fecal occult blood tests for colorectal cancer, Pap smear for cervical cancer, and mammography for breast cancer. These examinations are recommended for population-based screening as there is sufficient evidence to suggest that these tests reduce the cancer mortality rate in Japan (Hamashima et al., 2008; Hamashima et al., 2010; National cancer center, 2013). Of all municipalities, 1,718 (98.4%), 1,610 (92.2%), 1,726 (98.9%), 1,717 (98.3%), and 1,693 (97.0%) municipalities were included in the analyses for gastric, lung, colorectal, cervical, and breast cancer screening, respectively.

Statistical analysis

Partial correlation coefficients were calculated to quantitatively evaluate the relationships between cancer screening rates and the strategies used to improve screening rates in various municipalities. The coefficients indicate how closely each strategy is related to the cancer screening rate after excluding the effects of confounding factors, including the other three strategies, the number of eligible persons, the ratio of males to females, and the percentage of elderly.

The relationships between cancer screening rates and the strategies may vary with the population size of the municipalities. Therefore, partial correlation coefficients were also separately calculated for large municipalities (with populations of over 30,000) and small municipalities (with populations of under 30,000). In 2009, a municipality was seen as a city if the population was over 30,000, but seen as a town or village if not. All analyses were performed using STATA version 12 (StataCorp, College Station, TX, USA).

Results

The characteristics of cancer screening in Japan are presented in Table 1. The average screening rates for gastric, lung, colorectal, cervical, and breast cancer were 15.8%, 27.4%, 21.4%, 16.9%, and 13.2%, respectively. The strategy of sending invitation letters was implemented at about 55% of the municipalities, whereas personal visitations by community health workers were implemented at only 6% of all municipalities. Free screening was implemented at 23% of all municipalities for lung cancer screening and at 7-10% of all municipalities

Table 2. Partial Correlations between Cancer Screening Rates and Strategies Used to Improve Screening Rates in Japan

Variable	Gastric	Lung	Colorectal	Cervical	Breast
			All municipalities		
Number of municipalities	1,718	1,610	1,726	1,717	1,693
Strategies					
Sending personal invitation letters d	0.28[a]	0.32[a]	0.30[a]	0.26[a]	0.13[a]
Personal visitations by community health workers d	0.23[a]	0.15[a]	0.22[a]	0.18[a]	0.12[a]
Number of individuals screened in clinical settings	0.17[a]	0.19[a]	0.21[a]	0.25[a]	0.18[a]
Free screening d	0.03	0.13[a]	0.06[b]	0.08[a]	0.01
Characteristics of eligible persons					
Number of eligible persons	-0.24[a]	-0.26[a]	-0.23[a]	-0.28[a]	-0.21[a]
Ratio of males to females	0.07[a]	0.09[a]	0.03	-	-
Percentage of those aged ≥65 years	0.07[a]	0.20[a]	0.12[a]	-0.01	-0.13[a]
			Large municipalities (population ≥30,000)		
Number of municipalities	809	767	812	808	800
Strategies					
Sending personal invitation letters d	0.39[a]	0.39[a]	0.36[a]	0.30[a]	0.17[a]
Personal visitations by community health workers d	0.15[a]	0.11[a]	0.15[a]	0.06[c]	0.07[b]
Number of individuals screened in clinical settings	0.28[a]	0.31[a]	0.35[a]	0.41[a]	0.28[a]
Free screening d	0.05	0.14[a]	0.08[b]	0.04	0.03
Characteristics of eligible persons					
Number of eligible persons	-0.32[a]	-0.32[a]	-0.33[a]	-0.43[a]	-0.31[a]
Ratio of males to females	-0.02	0.02	-0.07[b]	-	-
Percentage of those aged ≥65 years	0.05	0.17[a]	0.03	0.01	-0.06[c]
			Small municipalities (population <30,000)		
Number of municipalities	909	843	914	909	893
Strategies					
Sending personal invitation letters d	0.25[a]	0.30[a]	0.29[a]	0.24[a]	0.11[a]
Personal visitations by community health workers d	0.22[a]	0.13[a]	0.22[a]	0.20[a]	0.12[a]
Number of individuals screened in clinical settings	0.15[a]	0.09[a]	0.11[a]	0.20[a]	0.19[a]
Free screening d	0.02	0.13[a]	0.02	0.09[a]	0.00
Characteristics of eligible persons					
Number of eligible persons	-0.36[a]	-0.29[a]	-0.34[a]	-0.36[a]	-0.28[a]
Ratio of males to females	-0.01	0.02	-0.02	-	-
Percentage of those aged ≥65 years	0.01	0.16[a]	0.10[a]	-0.05	-0.15[a]

* [a]p values ≤0.01; [b]p values ≤0.05; [c]p values ≤0.1; [d]Dummy variables

for other types of cancer screening. The average number of individuals that had been screened in the clinical setting was the largest for colorectal cancer screening, and the smallest for gastric cancer screening.

The average cancer screening rates were higher in small municipalities than large municipalities for all cancer screening. Personal visitations by health workers were implemented in about 9% of all small municipalities, which was about 6% higher than that of large municipalities for all screenings. The average number of individuals screened in the clinical setting of large municipalities was more than 20-fold greater than that of small municipalities for all cancer screening. This may be because many small municipalities did not implement cancer screening in the clinical setting (i.e., about 80% for gastric, lung, and colorectal cancers, 27% for cervical cancers, and 43% for breast cancers).

The partial correlation coefficients for the relationships between cancer screening rates and the strategies used in Japan are presented in Table 2. In all municipalities, there were positive correlations between the screening rates for all cancers and the strategies used, with the exception of free screening ($p<0.01$). Of the four strategies, sending personal invitation letters had the highest correlation coefficients with cancer screening rates. They were as follows: 0.28 for gastric cancer screening, 0.32 for lung cancer screening, 0.30 for colorectal cancer screening, and 0.26 for cervical cancer screening. For cervical cancer screening, the correlation between the number of individuals screened in the clinical setting and the screening rates was similar to that of sending invitation letters. For breast cancer screening, all strategies had a low or no correlation with the screening rates in all municipalities.

In large municipalities, the correlation coefficients between sending invitation letters and the screening rates were relatively high. Specifically, they were as follows: 0.39 for gastric cancer screening, 0.39 for lung cancer screening, 0.36 for colorectal cancer screening, and 0.30 for cervical cancer screening. In large municipalities, the correlation coefficients between the number of individuals screened in the clinical setting and the screening rates were also relatively high, particularly for cervical cancer screening ($r=0.41$). For breast cancer screening, the correlation coefficient rose to 0.28 in large municipalities. In small municipalities, the correlation coefficients between cancer screening rates and the strategies used were similar to those of all municipalities, with the exception of the number of individuals screened in the clinical setting.

Discussion

In Japan, the National Cancer Control Plan was published in 2007 with the aim of increasing cancer screening rates above 50% within 5 years (MHLW, 2012a). To achieve this goal, municipalities had to implement effective strategies that would increase screening for various types of cancer. Previous studies have shown that sending personal invitation letters (Watanabe, 2003; Shimada et al., 2010a; Shimada et al., 2010b; Matsuda et al., 2011), distributing leaflets and pamphlets (Hisamichi et al., 1991; Yoshida et al., 2012), and increasing the availability of cancer screening in clinical settings (Takaku, 2011) were effective in improving cancer screening rates in Japan. However, it was unclear which strategy was the most effective. In the present study, after excluding the effects of confounding factors, correlations between four different strategies and cancer screening rates were evaluated.

Of all strategies, sending personal invitation letters had the highest positive correlations with screening rates for gastric, lung, colorectal, and cervical cancers. This strategy appears to be particularly effective in improving cancer screening rates in large municipalities. In most Western countries, the importance of a national call-recall system, which gives call and recall notifications by mail or telephone, is well recognized by the government for the purposes of increasing cancer screening (Quinn et al., 1998; Baron et al., 2008b). In Japan, municipalities are responsible for implementing strategies to improve cancer screening rates. However, nearly half of the municipalities did not implement this strategy. To improve cancer screening rates, all municipalities need to prioritize establishing a system that sends personal invitation letters for cancer screening.

The number of individuals that had been screened in the clinical setting also demonstrated positive correlations with all cancer screening in large municipalities. The correlation was particularly high for cervical cancer screening. Previous studies reported on the effectiveness of making access to screening easier by reducing the time or distance between the service delivery settings and the examinees in increasing colorectal and breast cancer screening in Western countries (Dolan et al., 1999; Baron et al., 2008c). Thus, increasing the availability of screening in the clinical setting should be effective in improving the screening rates for not only colorectal and breast cancer, but also for cervical cancer, in Japan. However, the quality assurance of cancer screening in the clinical settings was insufficient compared to that of mass screening in Japan (Arisue et al., 2007; Osaka City, 2010). Additionally, many small municipalities did not implement cancer screening in the clinical setting (i.e., about 80% for gastric, lung, and colorectal cancers, 27% for cervical cancers, and 43% for breast cancers). This may be due to several reasons. For example, small municipalities have been under more severe fiscal constraints than large municipalities (Ministry of Internal Affairs and Communications, 2011), and consequently are more likely not to have any incentives for increasing cancer screening in the clinical settings (Takaku, 2011). Thus, to increase cancer screening in the clinical setting, particularly in small municipalities, these problems need to be resolved.

Personal visitations by community health workers had low, but positive, correlations with cancer screening rates compared to sending invitation letters and the number of individuals that were screened in the clinical setting. However, these correlations were higher in small municipalities versus large municipalities. This may be because this strategy was implemented better in small municipalities than large municipalities. This strategy

is unlikely to be implemented in large municipalities because it is difficult to employ many community health workers for the number of eligible persons. It was previously reported that the cost effectiveness of one-on-one education per additional mammogram increased substantially if the cost of labor increased (Stockdale et al., 2000). Thus, each municipality needs to pay sufficient attention to fiscal constraints and decide whether to implement this strategy.

Free screening had a weak correlation with cancer screening rates. To improve screening rates, the MHLW had initiated a strategy that distributed free coupons to some individuals for breast and cervical cancer screening beginning in 2009 and for colorectal cancer screening beginning in 2011. The distribution of free coupons improved the screening rates for women who had not been screened for cervical cancer in Fukuoka Prefecture (Kuroki, 2012). However, changes in price for cancer screenings had little influence on demand for screenings in Hokkaido Prefecture (Takemura et al., 2001). The CDC recommends interventions that reduce out-of-pocket costs for breast cancer screening, but does not recommend such interventions for cervical and colorectal cancer screening due to insufficient evidence (Baron et al., 2008a; Sabatino et al., 2012; CPSTF, 2013). Therefore, reducing the out-of-pocket costs alone appears to be insufficient for improving the cancer screening rates.

However, it should be mentioned that none of the strategies had strong (or very high) correlations with cancer screening rates. For breast cancer screening, even sending personal invitations had a very low correlation with the screening rates. Therefore, just sending personal invitation letters and increasing the availability of screening in the clinical settings does not appear to greatly improve the cancer screening rates. The CDC recommends provider-oriented interventions, which evaluate the providers' performance and present the providers with the results, to increase cancer screening (Sabatino et al, 2008). The MHLW reported that implementing cancer screening and specific health checkups simultaneously improved cancer screening rates in some municipalities (MHLW, 2012b). In addition to these strategies, future studies that determine other effective strategies for improving cancer screening rates are warranted, including where screening occurs and the medical personnel involved (Tsunematsu et al., 2013).

This study has several limitations that need to be discussed. First, while using partial correlation analysis to determine the relationships between cancer screening rates and the strategies has provided some foundational knowledge on the topic, the causality of these relationships is still unclear. It is also necessary to consider that these findings may be a result of reverse causality, meaning that the implementation of strategies is influenced by cancer screening rates. Second, data on costs of the strategies implemented by each municipality could not be used in the analyses (Saywell et al., 1999; Stockdale et al., 2000; Saywell et al., 2003; Saywell et al., 2004). The cost-effectiveness of these strategies should be evaluated. Third, some municipalities might have conducted cancer screening not for all eligible persons but for very limited persons, such as those who sought to receive screening or had received a year before. Such municipalities should be excluded in the analyses. Fourth, it is necessary to further evaluate which strategies are more effective than those studied herein.

In conclusion, of the strategies used to improve cancer screening rates, sending personal invitation letters had the greatest positive correlations with screening rates for gastric, lung, colorectal, and cervical cancers. This strategy appears to be particularly effective in improving cancer screening rates in large municipalities. All municipalities should predominantly focus on establishing a system that sends personal invitation letters for cancer screening. In large municipalities, increasing the availability of screening in the clinical setting may also be effective in improving cancer screening rates.

Acknowledgements

This study was supported by National Cancer Center, Tokyo, Japan (Grant number: 23-A-41). The authors have no competing interests.

References

Arisue T, Yasuda I, Eizuka T, et al (2007). Current status and issues for individual cancer screening. *J Gastroenterol Cancer Screen*, **45**, 172-82.

Baron RC, Rimer BK, Coates RJ, et al (2008a). Methods for conducting systematic reviews of evidence on effectiveness and economic efficiency of interventions to increase screening for breast, cervical, colorectal cancers. *Am J Prev Med*, **35**, 26-33.

Baron RC, Rimer BK, Breslow RA, et al (2008b). Client-directed interventions to increase community demand to breast, cervical, colorectal cancer screening: a systematic review. *Am J Prev Med*, **35**, 34-55.

Baron RC, Rimer BK, Coates RJ, et al (2008c). Client-directed interventions to increase community access to breast, cervical, colorectal cancer screening: a systematic review. *Am J Prev Med*, **35**, 56-66.

Blumenthal DS, Smith SA, Majett CD, Alema-Mensah E (2010). A trial of 3 interventions to promote colorectal cancer screening in African Americans. *Cancer*, **116**, 922-9.

Champion V, Maraj M, Hui S, et al (2003) Comparison of tailored interventions to increase mammography screening in nonadherent older women. *Prev Med*, **36**, 150-8.

Community Preventive Services Task Force (2013). Cancer prevention and control: client-oriented interventions to increase breast, cervical, colorectal cancer screening. [http://www.thecommunityguide.org/cancer/screening/client-oriented/index.html]

Dolan N, McDermott M, Morrow M, Venta L, Martin G (1999). Impact of same-day screening mammography availability: results of a controlled clinical trial. *Arch Intern Med*, **159**, 393-8.

Frie KG, Ramadas K, Anju G, et al (2013). Determinants of participation in a breast cancer screening trial in Trivandrum District, India. *Asian Pac J Cancer Prev*, **14**, 7301-7.

Hamashima C, Shibuya D, Yamazaki H, et al (2008). The Japanese guidelines for gastric cancer screening. *Jpn J Clin Oncol*, **38**, 259-67.

Hamashima C, Aoki D, Miyagi E, et al (2010). The Japanese guideline for cervical cancer screening. *Jpn J Clin Oncol*, **40**, 485-504.

Hannon PA, Vu T, Ogdon S, et al (2012). Implementation and Process Evaluation of a Workplace Colorectal Cancer Screening Program in Eastern Washington. Health Promot Pract, first published on Jul 13.

Hisamichi S, Fukao A, Sugawara N, et al (1991). Evaluation of mass screening programme for stomach cancer in Japan. Cancer Screening, UICC, Cambridge University Press, Cambridge, 357-72.

King ES, Rimer BK, Seay J, Balshem A, Engstrom PF (1994). Promoting mammography use through progressive interventions: Is it effective? *Am J Public Health*, **84**, 104-6.

Kuroki H (2012). Survey on the trends in uterine cervical cancer screening in Japanese women: The efficacy of free coupons in the screening. *J Obstet Gynaecol Res*, **38**, 35-9.

Lee MH, Lee YY, Jung DW, et al (2012). Effectiveness of interventions to increase the participation rate of gastric cancer screening in the republic of Korea: a pilot study. *Asian Pac J Cancer Prev*, **13**, 861-6.

Lobb R, Opdyke KM, McDonnell CJ, et al (2011). Use of evidence-based strategies to promote mammography among medically underserved women. *Am J Prev Med*, **40**, 561-5.

Matsuda T, Monnma T, Oizumi H, et al (2011). Measures to improve the cancer screening rate in Yamagata prefecture. *J Gastroenterol Cancer Screen*, **49**, 252-9.

McAvoy BR, Raza R (1991). Can health education increase uptake of cervical smear testing among Asian women? *BM J*, **302**, 833-6.

Ministry of Health, Labour, Welfare (2010). Report on regional public health services and health promotion services.

Ministry of Health, Labour, Welfare (2012a). The National Cancer Control Plan.

Ministry of Health, Labour, Welfare (2012b). Assessment on progress of the medical care expenditure regulation plan (mid-year/ FY 2010).

Ministry of Internal Affairs and Communications (2011). Annual report on municipal finances FY 2009.

National cancer center (2013). Recommendation for cancer screenings.

OECD (2011). StatExtracts.

Osaka City (2010). Cancer screenings in the future in Osaka City.

Quinn M, Babb P, Jones J, Allen E (1998). Effect of screening on incidence of and mortality from cancer of cervix in England: evaluation based on routinely collected statistics. *BMJ*, **318**, 904-8.

Sabatino SA, Lawlence B, Elder R, et al (2012). Effectiveness interventions to increase screening for breast, cervical, colorectal cancers: nine updated systematic reviews for the guide to community preventive services. *Am J Prev Med*, **43**, 97-118.

Sabatino SA, Habarta N, Baron RC (2008) Interventions to increase recommendation and delivery of screening for breast, cervical, colorectal cancers by healthcare providers: systematic reviews of provider assessment and feedback and provider incentives. *Am J Prev Med*, **35**, 67-74.

Saywell RM Jr, Champion VL, Skinner CS, Menon U, Daggy J (2004). A cost-effectiveness comparison of three tailored interventions to increase mammography screening. *J Womens Health*, **13**, 909-18.

Saywell RM Jr, Champion VL, Zollinger TM, et al (2003). The cost effectiveness of 5 interventions to increase mammography adherence in a managed care population. *Am J Manag Care*, **9**, 33-44.

Saywell RM Jr, Champion VL, Skinner CS, et al (1999). Cost-effectiveness of five interventions to increase mammography screening. *Prev Med*, **29**, 374-82.

Shimada T, Kato K, Inomata Y, Kikuchi R, Shibuya D (2010a). Evaluation of recall letters and application methods in view of increasing gastric cancer screening rates. *J Gastroenterol Cancer Screen*, **48**, 647-54.

Shimada T, Kato K, Inomata Y, Kikuchi R, Shibuya D (2010b). Evaluation of recall letters and application methods in view of increasing colorectal cancer screening rates. *J Gastroenterol Cancer Screen*, **48**, 655-62.

Stockdale S, Keeler E, Duan N, Derose K, Fox S (2000). Cost and cost-effectiveness of a church-based intervention to promote mammography screening. *Health Serv Res*, **35**, 1037-57.

Suh M, Choi KS, Lee YY, Park B, Jun JK (2013). Cancer screening in Korea, 2012: results from the Korean National Cancer Screening Survey. *Asian Pac J Cancer Prev*, **14**, 6459-63.

Takaku R (2011). Do municipalities want to increase checkup rates of cancer screening tests?: an empirical analysis on the implementation of individual cancer checkup system. *Iryo To Shaka*i, **21**, 121-36.

Takemura S, Sone T, Ohida T, et al (2001). Estimating price elasticities of demand for cancer screening programs: using the willingness to pay the user fee measured by the contingent valuation method. *Byoin Kanri*, **38**, 119-28.

Tsunematsu M, Kawasaki H, Masuoka Y, Kakehashi M (2013). Factors affecting breast cancer screening behavior in Japan - assessment using the health belief model and conjoint analysis. *Asian Pac J Cancer Prev*, **14**, 6041-8.

Townsend JS, Richardson LC, Steele CB, White DE (2009). Evidence-based interventions and screening recommendations for colorectal cancer in comprehensive cancer control plans: a content analysis. *Prev Chronic Dis*, **6**, 1-9.

Watanabe R (2003). An analysis of participation in cancer screening in Japan. *Iryo To Shakai*, **13**, 113-32.

Yoshida M, Kondo K, Nakanishi C, Tada T (2012). Interventional study for improvement of lung cancer screening rate. *J Med Invest*, **59**, 127-35.