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Awareness of and adherence to cancer screening guidelines among health professionals in Japan

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Since 1998 in Japan, guidelines for cancer screening programs have been developed and revised by a research group funded by the Ministry of Health, Labour and Welfare. However, little is known about health professionals' awareness of and adherence to the cancer screening guidelines. Surveys were conducted by mailing questionnaires to two target groups of health professionals: local government officers of municipal cancer screening programs of 3327 municipalities in 47 prefectures (local government officers group; *n* = 3327) and councilors of an academic society dealing with a mass survey of gastroenterological cancer (expert group; *n* = 195). The questionnaire contained questions dealing with: (1) awareness of and adherence to the cancer screening guidelines published in 2001, and (2) basic knowledge of and attitude towards cancer screening. We compared the responses of the two groups. The response rate in both groups was approximately 65%. Over 70% of the respondents were aware of the cancer screening guidelines. However, 20% of the local government officers and 35% of the experts thought that non-recommended methods could be used for population-based screening. Fifty-six percent of the local government officers and 76% of the experts responded that there was no problem with using non-recommended methods for opportunistic screening. Almost all health professionals believed that screening was 'almost always a good idea'. Although the two groups' backgrounds differed, both did not sufficiently understand the evidence-based approach for cancer screening. To properly conduct evidence-based cancer screening, it is necessary that health professionals have an appropriate understanding of the guidelines. (*Cancer Sci* 2007; 98: 1241–1247)

In Japan, guidelines for cancer screening have been developed and revised by a research group funded by the Ministry of Health Labour and Welfare (MHLW) since 1998. In 2001, six cancer screening programs (including screening for hepatocellular carcinoma by hepatitis virus markers) were recommended.[1]

There are two types of cancer screening: population-based screening and opportunistic screening. Although the aim of both screening programs is to reduce cancer mortality, their implementation differs.[2] In Japan, population-based screening programs are conducted in the following manner. The Health Service Law for the Aged introduced cancer screening programs in 1983. At present, five cancer screening programs (stomach, cervix, lung, breast and colon) are conducted nationwide, and over 25 million people are screened annually.[3] Before 1998, the national, prefectural and local (city, town and village) governments each paid one-third of the fees, and the local government had the primary responsibility of conducting the programs. In 1998, the national and prefectural governments stopped specific subsidies for cancer screening. Since that time, local governments have determined whether or not they conduct specific cancer screening programs; however, most of them continue to follow the official national government recommendations and offer five cancer screening programs. In addition, some offer new cancer screening modalities that are not supported by sufficient evidence of their reliability. For example, screening modalities using prostate-specific antigen (PSA) for prostate cancer and ultrasonography for breast cancer have attracted public interest, and have been introduced by several local governments. In contrast to population-based screening programs, opportunistic screening is conducted mainly as part of multiphasic health check-ups. This type of program is also common and is done in clinical settings where various new modalities, such as positron emission tomography, are more likely to be used.[4] In order to reduce mortality from cancer, both population-based screening and opportunistic screening programs need to be evidence-based.

To increase the screening rate, it is necessary to disseminate the correct information and to support appropriate decision making.[5,6] The public is increasingly exposed to various sources of information about cancer screening modalities of both proven and unproven efficacy. It is becoming more difficult for an individual to decide whether to participate in appropriate cancer screening without obtaining advice from health professionals. At the local municipality level, public health nurses and physicians have been involved in making decisions about the implementation of cancer screening programs. In local municipalities, the opinions of local medical experts (usually representatives of local medical associations) have strongly influenced the choice of cancer screening modalities. However, the knowledge and attitudes of public health nurses who work as local government officers has directly affected participation in cancer screening. Furthermore, at the time of opportunistic screening, physicians' recommendations can influence individuals' decisions regarding participation in cancer screening programs.[7–10] Several studies have reported that various health professionals have different levels of knowledge about cancer screening.[11–17] It is important that health professionals have the correct information to encourage individuals to participate in cancer screening programs.

To disseminate the correct information about conducting evidence-based screening programs, it is preferable that guidelines are used for decision making. However, there is little known about the awareness of and adherence to cancer screening guidelines among health professionals in Japan. Therefore, we conducted surveys among health professionals dealing with their awareness of guidelines, knowledge related to cancer screening, and their attitude toward cancer screening. Surveys were conducted by mailing questionnaires to two target groups of health professionals: local government officers of municipal cancer screening programs and councilors of an academic society dealing with a mass survey of gastroenterological cancer. The results of the two groups of health professionals were compared and analyzed. Based on the results, the optimal procedures for providing information about the cancer screening guidelines are discussed.

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Methods

Subjects. The surveys were conducted by mailing questionnaires to two target groups: local government officers of municipal cancer screening programs from 3327 municipalities of 47 prefectures (local government officers group; $n = 3327$), and councilors of an academic society dealing with a mass survey of gastroenterological cancer (expert group; $n = 195$). The local government officers were primarily public health nurses, who plan cancer screening programs, offer information about cancer screening and encourage participation in cancer screening programs. They are also involved in the policy making process and the implementation of cancer screening programs in their municipalities. The second group consisted of councilors of the Japanese Society of Gastroenterological Mass Survey; the total membership of the society is approximately 3800 physicians, most of whom work primarily in gastric and colorectal cancer screening. They often have a significant role as cancer screening experts who advise on the screening methods used in their local municipalities.

Cancer screening guidelines. The aim of these guidelines was the promotion of evidence-based screening; they were not considered to be obligatory. These guidelines were intended for population-based screening. They were not intended for opportunistic screening.

The latest guidelines for cancer screening used the grading system of the US Preventive Task Force 2nd edition, which defined the level of evidence based on study design.[17] Methods that had reliable evidence of mortality reduction were recommended as being appropriate for cancer screening programs. The following six programs were recommended:[1] photofluorography for gastric cancer, fecal occult blood test for colorectal cancer, a combination of chest radiography and sputum cytology (limited to current smokers) for lung cancer, cervical cytology for cervical cancer, a combination of physical examination and mammography for breast cancer, and hepatitis virus markers for hepatocellular carcinoma.

Questionnaire. The questionnaire contained questions dealing with: (1) awareness of and adherence to the cancer screening guidelines published in 2001 (see Tables 1,2), and (2) basic knowledge related to screening efficacy and attitude towards cancer screening (see Table 3). In the first section, the questions dealt with the appropriateness of using a method not recommended for population-based screening as part of a public policy program and for opportunistic screening in clinical settings. In the second section, the questionnaire included questions regarding knowledge of and attitude towards cancer screening, which covered the same areas as those studied by Schwartz and colleagues in the USA.[18] The questions dealt with the value of screening and the respondents' understanding of controversies or uncertainties about screening. For the expert physician group, there were limited inquiries about the evaluation of cancer screening (see Table 4). In addition, the questionnaire included questions about the respondents' age, sex and occupation.

Surveys. The survey was conducted by mail. Each health professional was sent a self-administered survey consisting of a 10-page questionnaire and a preaddressed return envelope. The responses were returned anonymously. The surveys were sent out in July 2004 to the local government officers group, and in April 2005 to the expert group. Although we sent a reminder to the first group, we did not send a mail reminder to the second group but asked them to respond through an announcement at the annual meeting of their society in 2005. Differences in the responses between the two groups were assessed for statistical significance using the χ^2-test. The study was approved by the Institutional Review Board of the National Cancer Center of Japan.

Results

Characteristics of respondents. The characteristics of both groups are shown in Table 5. The two groups' response rates were similar ($P = 0.2865$); 67.8% (2255/3327) of the local government officers and 64.1% (125/195) of the experts responded. The local government officers ranged in age from 30 to 59 years; most respondents were in their 30s. In contrast, most members of the expert group were in their 50s. The sex ratio was different in the two groups; the local government officers group consisted primarily of female public health nurses, and the expert group consisted primarily of male physicians.

Understanding of cancer screening guidelines. In both groups, over 70% of the respondents were aware of the cancer screening guidelines published in 2001 (Table 1, Q1). The proportion stating that they understood the cancer screening guidelines ('completely understand' and 'understand') was higher in the expert group than in the local government officers group (Table 1, Q2, $P < 0.0001$). Twenty-eight percent of the local government officers did not use the cancer screening guidelines (Table 1, Q3); others made use of the guidelines mainly to plan cancer screening programs. The expert group used the guidelines to explain cancer screening to participants. Both groups believed that it was important to inform their academic association colleagues and cancer screening participants about the efficacy of cancer screening (Table 1, Q4 and Q5). Most of the local government officers accepted the need to have guidelines to help inform others about cancer screening; however, fewer local government officers than experts believed in the importance of informing colleagues ($P = 0.0004$) and cancer screening participants ($P = 0.0021$).

Implementation of non-recommended methods for cancer screening. We compared the current methods used for cancer screening programs by local municipalities with the methods recommended in the guidelines. Breast cancer screening by physical examination was conducted in 479 municipalities (Table 1, Q6). Fifty-eight percent of municipalities conducted prostate cancer screening using PSA for population-based screening, which was not recommended. However, in the expert group, over 30% of the respondents conducted gastric cancer and hepatocellular carcinoma screening using methods that were not recommended. The prime screening methods that were used were endoscopy for gastric cancer and abdominal ultrasonography for hepatocellular carcinoma. The local government officers stated that the prime reason for using non-recommended methods was the advice received from specialists; the next reason was the high detection rates that could be obtained using these methods (Table 1, Q7). In the expert group, requests from participants and high detection rates were the main reasons for using methods not recommended by the cancer screening guidelines.

Preference of non-recommended methods for cancer screening. We asked the respondents about the appropriateness of conducting cancer screening using non-recommended methods for population-based and opportunistic screening. Given the evidence, non-recommended methods should not be used for population-based and opportunistic screening. However, almost half of the local government officers were uncertain about the appropriateness of conducting cancer screening using non-recommended methods for population-based screening as part of public health policy (Table 1, Q8). Only 32% of the local government officers responded correctly that non-recommended methods should not be used. In the expert group, 46.4% responded correctly that non-recommended methods should not be used, and 17.6% were uncertain about the use of non-recommended methods. A similar question was asked about using non-recommended methods for opportunistic screening; in both groups, the greatest number responded that non-recommended methods could be used for opportunistic screening rather than for population-based screening

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Table 1. Understanding and utilization of cancer screening guidelines

No.	Question	Local government officers group	Expert group	*P*-value
		n (%)	*n* (%)	
Q1	Do you know about the cancer screening guidelines published in 2001?			
	Number of responses	2255	125	0.0006
	Yes	1637 (72.6)	109 (87.2)	
	No	594 (26.3)	16 (12.8)	
Q2	Do you understand the cancer screening guidelines?			
	Number of responses	1637	125	<0.0001
	Completely understand	53 (3.2)	44 (35.2)	
	Understand	719 (43.9)	52 (41.6)	
	Slightly understand	835 (51.0)	11 (8.8)	
	Do not understand	5 (0.3)	0	
Q3	Do you use the cancer screening guidelines, and, if so, how? (including duplicate answers)			
	Number of responses	1637	125	-
	No	455 (27.8)	17 (13.6)	
	Planning cancer screening programs	961 (58.7)	38 (30.4)	
	Explanations for participants in cancer screening	441 (26.9)	50 (40.0)	
	Material for lectures and workshops	116 (7.1)	68 (54.4)	
	Other	46 (2.8)	2 (1.6)	
Q4	Is there any need to inform colleagues of the effectiveness of cancer screening?			
	Number of responses	2255	125	0.0004
	Yes	1750 (77.6)	105 (84.0)	
	No	27 (1.2)	6 (4.8)	
	Not sure	415 (18.4)	13 (10.4)	
Q5	Is there any need to inform participants of the effectiveness of cancer screening?			
	Number of responses	2255	125	0.0021
	Yes	1490 (66.1)	103 (82.4)	
	No	228 (10.1)	10 (8.0)	
	Not sure	497 (22.0)	12 (9.6)	
Q6	What cancer screening do you conduct using methods not recommended? (including duplicate answers)			
	Number of responses	2255	125	-
	Gastric cancer screening	101 (4.5)	49 (39.2)	
	Lung cancer screening	80 (3.5)	23 (18.4)	
	Cervical cancer screening	21 (0.9)	1 (0.8)	
	Breast cancer screening (physical examination)	479 (21.2)	4 (3.2)	
	Colorectal cancer screening	23 (1.0)	23 (18.4)	
	Hepatocellular carcinoma screening	51 (2.3)	38 (30.4)	
	Prostate cancer screening	1299 (57.6)	14 (11.2)	
Q7	Why do you conduct cancer screening using methods not recommended? (including duplicate answers)			
	Number of responses	769	61	-
	Recommendation by experts (e.g. physician)	240 (31.2)	4 (6.6)	
	High detection rate	207 (26.9)	33 (54.1)	
	Requests from participants of cancer screening	204 (26.5)	37 (60.7)	
	Low screening cost (charge)	69 (9.0)	6 (9.8)	
	New method	43 (5.6)	9 (14.8)	
	High screening rate	43 (5.6)	5 (8.2)	
	Other	355 (46.2)	15 (24.6)	
Q8	For population-based screening as public policy, do you think that it is appropriate to conduct cancer screening using methods that are not recommended?			
	Number of responses	2255	125	<0.0001
	Yes	456 (20.2)	44 (35.2)	
	No	710 (31.5)	58 (46.4)	
	Not sure	1031 (45.7)	22 (17.6)	
Q9	For opportunistic screening in the clinical setting, do you think that it is appropriate to conduct cancer screening using methods that are not recommended?			
	Number of responses	2255	125	0.0033
	Yes	1270 (56.3)	93 (74.4)	
	No	283 (12.5)	20 (16.0)	
	Not sure	662 (29.4)	11 (8.8)	

Table 2. Awareness of screening efficacy of cancer screening programs among local government officers

Question	Answer	Municipalities by use of non-recommended methods for cancer screening programs (n = 2255)				P-value
		Using (n = 769)		Not using (n = 1486)		
		n	%	n	%	
Q8 For population-based screening as public policy, do you think that it is appropriate to conduct cancer screening using methods that are not recommended?	Yes	234	30.4	222	14.9	<0.0001
	No	190	24.7	520	35.0	
	Not sure	330	42.9	701	47.2	
Q9 For opportunistic screening in the clinical setting, do you think that it is appropriate to conduct cancer screening using methods that are not recommended?	Yes	484	62.9	786	52.9	<0.0001
	No	72	9.4	211	14.2	
	Not sure	207	26.9	455	30.6	

Table 3. General beliefs about cancer screening

No.	Question	Local government officers group	Expert group	P-value
		n (%)	n (%)	
Q10	Routine screening means testing healthy persons to find cancer before they have any symptoms. Do you think routine cancer screening tests for healthy persons are almost always a good idea?			
	Number of responses	2255	125	0.0115
	No	4 (0.2)	0	
	Yes	2184 (96.9)	119 (95.2)	
	Not sure	16 (0.7)	4 (3.2)	
Q11	How often does finding cancer early mean that treatment saves lives?			
	Number of responses	2255	125	<0.0001
	None of the time	19 (0.8)	1 (0.8)	
	Some of the time	1282 (56.9)	35 (28.0)	
	Most of the time	917 (40.7)	80 (64.0)	
	All of the time	22 (1.0)	6 (4.8)	
Q12	How often does finding cancer early mean that a person can have less treatment?			
	Number of responses	2255	125	0.0020
	None of the time	12 (0.5)	1 (0.8)	
	Some of the time	1089 (48.3)	35 (28.0)	
	Most of the time	969 (43.0)	68 (54.4)	
	All of the time	171 (7.6)	17 (13.6)	
Q13	If there was a kind of cancer for which nothing can be done, would you want to be tested to see if you have it?			
	Number of responses	2255	125	0.0209
	No	754 (33.4)	52 (41.6)	
	Yes	781 (34.6)	44 (35.2)	
	Not sure	695 (30.8)	24 (19.2)	
Q14	Have you ever heard of cancers that grow so slowly that they are unlikely to cause you problems in your lifetime?			
	Number of responses	2255	125	<0.0001
	No	659 (29.2)	5 (4.0)	
	Yes	1252 (55.5)	114 (91.2)	
	Not sure	330 (14.6)	3 (2.4)	
Q15	Would you want to be tested to see if you had a slow-growing cancer like that?			
	Number of responses	2255	125	0.0020
	No	679 (30.1)	35 (28.0)	
	Yes	939 (61.6)	68 (54.4)	
	Not sure	619 (27.5)	18 (14.4)	

(Table 1, Q9). More of the expert group members than of the local government officers (74.4 vs 56.3%) responded that non-recommended methods could be used for opportunistic screening.

The responses of the local government officers were analyzed based on the use of non-recommended strategies in their municipalities (Table 2). With respect to the question concerning population-based screening as public policy, both groups had a

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Table 4. Evaluation indicators for and barriers to cancer screening for experts: opinions of experts

No.	Question	Answers	*n* (%)
Q16	What position do you have with respect to determining the cancer screening method?	I can determine	27 (21.6)
		I can advise	62 (49.6)
		I can't determine	19 (15.2)
		Others	3 (2.4)
		No answer	14 (11.2)
Q17	What kinds of factors are preferred for evaluating cancer screening efficacy? (including duplicate answers)	Mortality of specific cancer	52 (41.6)
		Sensitivity and specificity of screening test	42 (33.6)
		Survival rate of detected cancer	37 (29.6)
		Detection rate	32 (25.6)
		Proportion of early cancer among detected cancer	29 (23.2)
		Screening rate	24 (19.2)
		Incidence of specific cancer	15 (12.0)
		All-causes mortality	4 (3.2)
		Others	3 (2.4)
Q18	What kinds of barriers to cancer screening are there? (including duplicate answers)	Inconvenience	82 (65.6)
		Lack of information	72 (57.6)
		Screening cost	65 (52.0)
		Physical pain	59 (47.2)
		Anxiety regarding test safety	22 (17.6)
		Anxiety regarding breach of personal information	12 (9.6)
		Others	7 (5.6)

Theses questions were limited to the version for the expert group ($n = 125$).

Table 5. Characteristics of respondents

Characteristic	Local government officers group	Expert group
	n (%)	*n* (%)
Number in the target group	3327	195
Response rate	2255 (67.8)	125 (64.1)
Number of answers concerning characteristics of respondents	1874	125
Age (years)		
30–39	809 (43.2)	0
40–49	699 (37.3)	21 (16.8)
50–59	349 (18.6)	53 (42.4)
60–69	0	45 (36.0)
≥70	0	0
Sex		
Male	164 (8.8)	106 (84.8)
Female	1689 (90.1)	10 (8.0)
Occupation		
Physician	0	114 (91.2)
Nurse	1575 (84.0)	0
Other medical professionals	0	11 (8.8)
Other	231 (12.8)	0

high degree of uncertainty (42.9 vs 67.2%). More local government officers in municipalities using recommended strategies than in municipalities using non-recommended strategies responded that non-recommended strategies should not be used (Table 2, Q8). With regard to the question concerning opportunistic screening, most responses were incorrect in both groups, as they responded that non-recommended strategies could be used (62.9 vs 52.9%). More local government officers in municipalities using recommended strategies (14.2%) than in municipalities using non-recommended strategies (9.4%) answered this question correctly (Table 2, Q9).

Belief in early detection. Overall, more than 95% of health professionals answered that screening was 'almost always a good idea' (Table 3, Q10). Sixty-nine percent of the expert group answered that finding cancers early saves lives most or all of the time, whereas 42% of the local government officers thought so (Table 3, Q11, $P < 0.0001$). In a similar question (Q12) concerning the possibility that early detection leads to less treatment, the expert group agreed with this more than the local government officers group ($P = 0.0020$). In both groups, 35% of respondents wanted to be screened even if nothing could be done to prolong their lives (Table 3, Q13). One question (Q14) dealt with respondents' knowledge about pseudo-diseases that would not cause symptoms during their lifetimes. The two groups had different levels of knowledge about slow-growing cancers (55.5% of the local government officers group and 91.2% of the expert group knew about slow-growing cancers); over 60% of the respondents in both groups wanted to be screened for these cancers (Table 3, Q14, 15). Overall, both groups of health professionals were enthusiastic about cancer screening and wanted to know whether they had cancer.

Role of experts. Seventy percent of the experts were in a position to have an important role ('I can determine' or 'I can advise') in determining the screening methods used in their institutions or in their local municipalities (Table 4, Q16). However, one-third of these respondents answered incorrectly for questions dealing with the factors used to evaluate cancer screening, such as test sensitivity and specificity, and survival and detection rates (Table 4, Q17). These are important factors in cancer screening, but are not adequate endpoints for screening efficacy. Approximately 60% of the expert group answered that lack of information was a barrier to cancer screening (Table 4, Q18).

Discussion

To prevent premature death due to cancer, evidence-based strategies must be adopted for cancer screening programs. The most serious issue is the lack of knowledge about the appropriate methods that should be adopted as part of public

policy for use in population-based screening (Tables 1,2, Q8 and Q9). Over 50% of the expert group responded that they conducted programs using non-recommended methods (Table 1, Q6). A greater number of experts than local government officers, who were mainly public health nurses, responded that non-recommended methods could be used in both population-based and opportunistic screening. Similarly, PSA screening has been widely used despite the fact that there is no evidence that it reduces mortality.[19–21] Seventy-four percent of the expert group thought that there were no problems associated with using non-recommended methods for opportunistic screening. Most of the experts were physicians working in gastric and colorectal cancer screening programs whose efficacies have already been evaluated in Japan.[3,22,23] Based on their experience, the experts mostly believe that early detection is always valuable. It is possible that inadequate understanding by the experts may have led to the use of non-recommended methods for cancer screening.

Compared to local government officers, the cancer screening experts, mostly physicians, seemed to have sufficient knowledge about the issues surrounding cancer and cancer screening. However, this is not directly related to an adequate understanding of evidence-based health policy making. Among physicians, awareness of cancer screening guidelines is not necessarily related to an appropriate understanding of the guidelines.[24] In fact, more experts than local government officers responded that non-recommended methods could be used for population-based screening. This strongly indicates the necessity to develop an effective educational system about evidence-based health policy for experts.

Lack of awareness and lack of appropriate recommendations from physicians are the most commonly reported barriers to having screening tests.[25] Physicians' recommendations can affect whether individuals participate in cancer screening.[7] Several reports have dealt with changes in the participation rate of prostate cancer screening;[26–31] interventions targeted at physicians were effective in increasing the screening rates.[32] Health professionals need to be properly informed and have the responsibility to inform potential participants about cancer screening programs. Based on their knowledge about the appropriate evidence needed for cancer screening, they could minimize and prevent several major problems.[33] However, new technologies whose efficacy is unproven are also being promoted. Such ambivalent information can confuse individuals who must decide whether or not to participate in cancer screening programs. Guidelines can assist health professionals in making decisions about appropriate cancer screening. Based on the guidelines, they should not promote non-recommended methods for both population-based and opportunistic screening programs.

For health professionals, the cancer screening guidelines are a significant means of obtaining appropriate knowledge that could lead them to choose evidence-based strategies. However, the availability of clinical practice guidelines does not automatically lead to their dissemination. Physicians make their decisions based not only on the evidence but also on other factors.[19,20,34] Several studies have reported that clinical practice guidelines are difficult and inconvenient to use.[15,34,35] Thus, to promote an appropriate understanding of cancer screening guidelines, they should be presented in a format that is easy for health professionals to understand and use.

There are several limitations with respect to the interpretation of our findings. First, the response rate was not high; 68% of the local government officers and 64% of the experts responded. Second, the survey was sent at different times to the two health professionals (July 2004 to local government officers and April 2005 to the screening expert group). The guidelines were published in 2001, and in the same year the MHLW sent the guidelines to all municipalities. After that, the guidelines were gradually disseminated among health professionals through medical journals and meetings of academic societies. Because the first survey occurred 3 years after publication of the guidelines, a 9-month difference in the time between the two surveys would have had minimal effect on the awareness of the guidelines. Last, differences in the responses between the groups must be considered in light of the different backgrounds of the two groups, which included age and sex differences, as well as their specialty differences. Over 80% of the respondents had undergone cancer screening. The screening rates of these two groups were higher than the rate of the general population determined by a national survey targeting the general population.[36] The present study might have led to an overestimation of the value of cancer screening. In addition, our survey and a similar US survey had different target groups. Therefore, we could not compare our results with the results of the US survey.[18]

In conclusion, the present study demonstrated that there is a lack of appropriate knowledge about evidence-based health policy among health professionals in Japan. To conduct evidence-based screenings, an appropriate understanding of the cancer screening guidelines must be promoted.

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Evaluation of ^{18}F-2-deoxy-2-fluoro-glucose positron emission tomography for gastric cancer screening in asymptomatic individuals undergoing endoscopy

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^{18}F-2-deoxy-2-fluoro-glucose Positron Emission Tomography (FDG-PET) has been recently proposed as a promising cancer-screening test. However, the validity of FDG-PET in cancer screening has not been evaluated. We investigated the sensitivity of FDG-PET compared with upper gastric endoscopy in gastric cancer screening for asymptomatic individuals. A total of 2861 consecutive subjects (1600 men and 1261 women) who were asymptomatic and who underwent both FDG-PET and upper gastrointestinal endoscopy between 1 February 2004 and 31 January 2005 were included in this study. Both endoscopists and a radiologist were unaware of the results of the other diagnostic tests. The FDG-PET images were examined using criteria determined by the pattern of FDG accumulation. Sensitivity and specificity of FDG-PET were calculated compared with endoscopic diagnosis as the gold standard. Among 2861 subjects enrolled in the study, there were 20 subjects with gastric cancer, of whom 18 were T1 in depth of cancer invasion. Positive FDG-PET results were obtained only in 2 of the 20 cancer subjects. The calculated sensitivity and specificity for overall gastric cancers were 10.0% (95% confidence interval (CI): 1.2–31.7%) and 99.2% (95% CI: 98.8–99.5%), respectively. ^{18}F-2-deoxy-2-fluoro-glucose Positron Emission Tomography was poorly sensitive for detection of gastric cancer in the early stages.
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^{18}F-2-deoxy-2-fluoro-glucose Positron Emission Tomography (FDG-PET) is a technique that reflects the changes in glucose metabolism in tumour cells, and has been widely used clinically to differentiate between benign and malignant tumours (Rigo *et al*, 1996), to assess the effectiveness of chemotherapy or radiotherapy (Kelloff *et al*, 2005), and to predict prognosis (Oshida *et al*, 1998; Oku *et al*, 2002). The potential of FDG-PET for early detection of cancer has been investigated because the test enables scanning of the whole body simultaneously and non-invasively. Because of this advantage, there has been considerable enthusiasm for PET screening in Japan (Yasuda and Ide, 2005). About 60% of facilities in Japan that are equipped with PET offer PET examinations to individuals who hope to undergo cancer screening (Yasuda and Ide, 2005).

Gastric cancer is one of the most important cancers in terms of anticancer strategy because it ranks second in cancer mortality in Japan (World Health Organization Statistics, 2006). There are many other countries with patients at high risk for gastric cancer, such as those in Central and South America, Asia, and Eastern Europe. Although gastric cancer has decreased in most of the developed countries, its prevention remains an important issue in those countries. For early detection of gastric cancer, X-ray examination with a barium meal has been employed in Japan (Fukao *et al*, 1995). Efficacy of this kind of screening program has been strongly suggested, although the studies are observational (Oshima *et al*, 1986; Fukao *et al*, 1995; Mizoue *et al*, 2003). The problem with the program is that the screening test is somewhat invasive in terms of complications such as constipation being frequently seen and mis-swallowing of barium into the trachea (Tamura *et al*, 1985; Sugahara *et al*, 1992). On the other hand, with FDG-PET, there is almost no such inconvenience for screenees. For these reasons, FDG-PET has been explored as a potential alternative to the present screening test for gastric cancer in Japan. However, the validity of FDG-PET in cancer screening remains to be evaluated. Although the sensitivity of FDG-PET for gastric cancer is reported to be from 60 to 94%, most subjects evaluated in existing reports were limited to patients with advanced gastric cancers or recurrent cancers (Yeung *et al*, 1998; De Potter *et al*, 2002; Stahl *et al*, 2003; Yoshioka *et al*, 2003; Mochiki *et al*, 2004; Chen *et al*, 2005; Yun *et al*, 2005). There has been no study to measure screening sensitivity of FDG-PET for gastric cancer in average risk individuals. Therefore, in the present study, we investigated the sensitivity of FDG-PET for gastric cancer in asymptomatic individuals who underwent FDG-PET as well as screening upper gastrointestinal endoscopy, which served as the gold standard in calculating the sensitivity of FDG-PET.

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MATERIALS AND METHODS

Subjects and study design

The Research Center for Cancer Prevention and Screening (RCCPS), National Cancer Center (NCC), Tokyo, started the one-arm prospective cohort study designed to evaluate the efficacy of multiphasic cancer screening programs in 1 February 2004 (Hamashima *et al*, 2006). Details of the screening programs are described elsewhere (Hamashima *et al*, 2006). The screening programs consisted of upper and lower gastrointestinal endoscopy or X-ray examinations and other imaging modalities such as a chest helical CT examination. These examinations were performed during the 2-day course of the screening program. Individuals who were found to have cancer lesions were treated at the National Cancer Center Hospital. Participants were enrolled nationwide. Screenees were asymptomatic men 50 years or over and women 40 years or over who gave signed informed consent approved by the Ethics Committee for Clinical Research of the NCC. Subjects who were diagnosed as having any cancer within the past 1 year, or those who had been treated for cancer or followed-up for pre-cancerous diseases based on self-reporting were excluded. All participants responded to a questionnaire describing many issues concerning life style, family history, and previous examinations within a year (Hamashima *et al*, 2006). Individuals were to be followed up annually by a questionnaire on health status, diagnostic examinations (including results), and other relevant data.

The study population in the present study was defined as consecutive screenees who underwent both FDG-PET and gastrointestinal endoscopy between 1 February 2004 and 31 January 2005 within the screening program at the RCCPS. There were a total of 2911 individuals who underwent FDG-PET, among whom 2892 individuals, including 1626 men and 1266 women, also had gastric endoscopy and thus met the criteria for inclusion. Thirty-one individuals were excluded who had undergone gastrectomy. After excluding these subjects, the study population of 2861 participants, including 1600 men and 1261 women, was included in the analyses.

The endoscopic findings and images were examined by three skilled endoscopists (HS, YK, and TK) without any knowledge of FDG-PET findings. The FDG-PET images were examined by one expert radiologist specialising in nuclear medicine (TT), who had no information about the endoscopic findings. Findings and diagnoses were recorded separately by endoscopists and the radiologist on the electronic record system at the RCCPS to create the database of the participants. After the records were completed, findings from the two modalities were compared by either of the two investigators (HS and YM) to identify true positives and false negatives from FDG-PET results for gastric cancer based on endoscopic findings as the gold standard. Gastric cancer subjects were defined as those who were diagnosed as having gastric cancer at the time of screening or on additional endoscopy performed within 1 month after the screening.

The study protocol was approved by the Ethics Committee for Clinical Research of the NCC.

Information on cancers other than gastric cancers detected in the background population from which the present study population was drawn was described previously (Hamashima *et al*, 2006).

^{18}F-2-deoxy-2-fluoro-glucose Positron Emission Tomography procedure

The FDG-PET images were obtained using two multi-ring PET scanners (ECAT Accel, Siemens, Knoxville, TN, USA) with a transaxial resolution of 6.2 mm at full-width half-maximum. Subjects were required to fast for at least 5 h before the PET scan. Sixty minutes after injection of 2.78 MBq kg^{-1} of FDG that was produced in our radiopharmacy, emission and transmission scans were obtained from the head to the inguinal region. A three-dimensional emission scan was acquired in eight or nine bed positions for 2 min per position, followed by a two-dimensional transmission scan for 1 min per position to correct for photon attenuation using a 68Ge/Ga rod source. Images were reconstructed iteratively (ordered-subset expectation maximisation method, two iterations, eight subsets).

The standardised uptake value (SUV) was semiquantitated in the cases with uptakes suspected of being abnormal. The SUV can be calculated as the ratio of the FDG uptake in a small region of interest (placed over the lesion in an attenuation-corrected image) to the administered activity adjusted for the body weight of the patient (Bombardieri *et al*, 2003).

Assessment of FDG-PET findings

Criteria for the assessment of FDG-PET findings for gastric lesions vary among facilities despite the widespread use of the guidelines for the FDG-PET procedure, mainly due to the difficulties caused by physiological uptake in the stomach. Because there are no established criteria for assessing FDG-PET findings, we determined the following criteria based on previous reports (Cook *et al*, 1996; Gordon *et al*, 1997; Shreve *et al*, 1999; Koga *et al*, 2003): (1) positive pattern 1 - spotty or focal accumulation that was stronger than the uptake in the liver (Figure 1A); positive pattern 2 - any accumulation in the area of the lower stomach (Figure 1B). This category was based on a report by Koga *et al* (2003), suggesting that physiological gastric FDG uptake is significantly higher at the oral end than the anal end, and that a stronger gastric FDG uptake at the anal end might therefore be suggestive of a pathological uptake. (2) negative pattern 1 - no definite accumulation in the stomach (Figure 1C); negative pattern 2 - diffuse accumulation in the stomach, considered to be a normal physiological uptake (Figure 1D). The judgment of FDG-PET accumulation was made based only on PET without CT scan. Positive whole body FDG-PET findings were obtained in 9% of 2911 subjects who had FDG-PET examinations. Approximately one-fourth of those with positive FDG-PET required further investigation in addition to the examinations included in the screening program. Detailed information will be described elsewhere.

Upper gastrointestinal endoscopy

All subjects were administered a 100 ml solution containing 1 g of Pronase and 1 g of sodium bicarbonate to remove mucus and bubbles on the gastric mucosa before examination. The antiperistaltic (20 mg of scopolamine butylbromide or 1 mg of glucagon) and sedative (17.5–35 mg of pethidine hydrochloride or 2–10 mg of midazolam) agents were injected intravenously except when they were contraindicated. We used standard commercial video endoscopic equipment (GIF TYPE H-260 or Q260; Olympus Co., Tokyo, Japan). Endoscopic images were obtained and recorded in a standardised pattern, which covered the entire gastric mucosa in about 50 shots. We added chromoendoscopy with 0.2% solution of indigo-carmine in all subjects after conventional observation. All lesions that appeared potentially malignant were biopsied for histopathological examination. The location, description of lesions, and diagnosis were recorded just after the gastrointestinal endoscopy. Size of cancer lesions was measured on the surgically or endoscopically resected specimen. Endoscopic images were reviewed primarily on the same day by three endoscopists (HS, YK, and TK) to determine whether there were any lesions overlooked during endoscopy. If any suspicious findings were suggested to have been overlooked, the screenees were recommended to undergo an additional endoscopy.

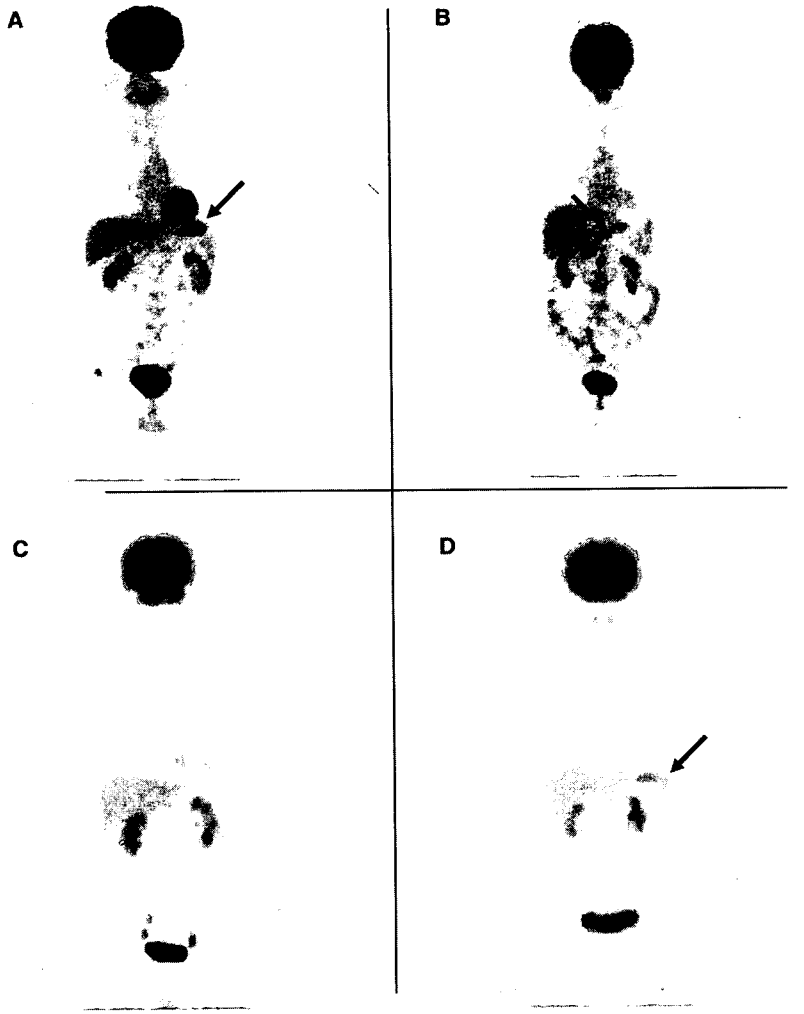

Figure 1 Assessment of FDG-PET findings. (**A**) PET scan demonstrates spotty or focal accumulation that is stronger than the uptake in the liver (arrow). (**B**) PET scan demonstrates focal accumulation in the area of the lower stomach (arrow). (**C**) PET scan demonstrates no definite accumulation of FDG in the stomach. (**D**) PET scan demonstrates diffuse accumulation (normal physiological accumulation) of FDG in the stomach (arrow).

Histopathological findings

The final pathological diagnosis was confirmed from specimens resected surgically or endoscopically. The depth of cancer invasion was recorded according to the TNM clinical classification (Sobin and Wittekind, 1997). Two pathologists interpreted the histopathologic features and when there was a disagreement, a senior pathologist reviewed the features to resolve the disagreement.

Statistical analyses

The Student's *t*-test was used to assess the difference in the mean age between gastric cancer subjects and those without gastric cancer or between male and female subjects. Statistical significance for comparison of items other than age between subjects with gastric cancer and subjects without gastric cancer was assessed by χ^2 test. The difference in SUV between true positives and false positives was also analysed by the Student's *t*-test. *P*-values <0.05 were considered statistically significant and 95% confidence intervals (CIs) were calculated based on a binominal distribution.

RESULTS

The characteristics of the subjects enrolled in the study are shown in Table 1. Among 2861 subjects enrolled in the study, gastric cancers were detected by gastrointestinal endoscopy in 20 subjects, including 18 men and 2 women. The mean age of all subjects was 59.8 years old, and there was no statistically significant difference between subjects with gastric cancer and subjects without gastric cancer. Males were older than females both among subjects with gastric cancer and subjects without gastric cancer. The proportion of males to females was significantly higher for subjects with gastric cancer than for subjects without gastric cancer (Table 1).

Table 1 Characteristics of subjects enrolled in this study

Variables	Subjects with gastric cancers ($n = 20$)	Subjects without gastric cancers ($n = 2841$)	P-value[§]
Age (mean ± s.d.) (year)			
Overall	63.1 ± 5.1	59.8 ± 7.0	0.0368
Male	64.1 ± 4.1	61.1 ± 6.0	0.0330
Female	53.5 ± 0.7	58.2 ± 7.7	0.3919
Sex			
Male/female	18/2	1582/1259	0.0043
Family history of gastric cancer			
Within second degree family	6	591	0.4638
Within first degree family	5	470	0.4769
Family history of any cancer			
Within second degree family	14	1842	0.8048
Within first degree family	11	1511	>0.9999
History of gastric examinations[a]	11	1578	>0.9999
Barium meal X-ray examination	8	1051	0.9640
Gastrointestinal endoscopy	4	780	0.6217
Characteristics of gastric cancer			
Location[b] (U area/M area/L area)	4/5/11		
Size[c] (−10 mm/11−20 mm/21 mm−)	6/7/7		
Histological type			
Differentiated adenocarcinoma (Well/Mod)	11(11/0)		
Undifferentiated adenocarcinoma (Por/Sig/Mixed (Sig/Por))	9(1/4/4)		

Mod = moderately differentiated adenocarcinoma; Por = poorly differentiated adenocarcinoma; Sig = signet ring cell carcinoma; Well = well-differentiated adenocarcinoma. [§]Statistical significance for comparison of each item between subjects with gastric cancer and without gastric cancer. [a]Proportion of subjects who had undergone stomach examination as a screening test or diagnostic test with X-ray examination and/or gastrointestinal endoscopy within 1 year before the screening endoscopy in this study. [b]Location of a lesion is based on the 'Japanese Classification of Gastric Carcinoma' (The 13th Edition, 1999) by Japanese Gastric Cancer Association. [c]Maximum diameter of cancer lesions.

Table 2 FDG-PET results according to depth of cancer invasion

		Depth of invasion[a]			
		T1	T2	T3	T4
FDG-PET positive	$n = 2$	1	0	0	1
FDG-PET negative	$n = 18$	17	1	0	0
Total	$n = 20$	18	1	0	1

FDG-PET denotes ^{18}F-2-deoxy-2-fluoro-glucose positron emission tomography. T1: tumour invades lamina propria or submucosa. T2: tumour invades muscularis propria or subserosa. T3: tumour penetrates serosa (visceral peritoneum) without invasion of adjacent structures. T4: tumour invades adjacent structures. [a]The depths of cancer invasion were based on the TNM classification.

Table 3 Sensitivity and specificity of FDG-PET for gastric cancer

	Subjects with gastric cancers ($n = 20$)	Subjects without gastric cancers ($n = 2841$)
FDG-PET positive $n = 24$	2	22
FDG-PET negative $n = 2837$	18	2819

CI = confidence interval. Sensitivity (95% CI) = 2/20 = 10% (1.2−31.7%). Specificity (95% CI) = 2819/2841 = 99.2% (98.8−99.5%). Positive predictive value = 2/24 = 8.3% (1.0−27.0%). Negative predictive value = 2819/2837 = 99.4% (99.0−99.6%).

There was no significant difference in the frequency of family history of gastric or any other cancer, or of previous examinations between subjects with gastric cancer and subjects without gastric cancer (Table 1).

Detailed clinical features of gastric cancers detected by endoscopy are shown in the bottom of Table 1. Histopathologically, about half of the cancers were well or moderately differentiated adenocarcinoma. Of the 20 gastric cancers, 18 were of T1 stage (Table 2), among which cancer invasion into the gastric wall was confined to the mucosa in 12 subjects, and to the submucosa in six subjects. Only two subjects among 20 cases with gastric cancer showed positive results with PET. The first patient had T4 cancer (Borrmann type 2, poorly differentiated adenocarcinoma), and the FDG-PET showed strong and focal accumulation in the area of the upper gastric body as 'positive pattern 1'. The second patient had T1 cancer (a superficial depressed type, signet ring cell carcinoma), and the FDG-PET showed stronger accumulation in the area of the lower gastric body, which was clearly judged as 'positive pattern 2'.

The overall sensitivity, specificity, and positive predictive values were 10.0% (95% CI: 1.2−31.7%), 99.2% (95% CI: 98.8−99.5%), and 8.3% (95% CI: 1.0−27.0%), respectively, and the negative predictive value was 99.4% (95% CI: 99.0−99.6%) (Table 3). There were 22 subjects with positive FDG- PET accumulation in addition to two cases of gastric cancer. These 22 subjects had no other neoplastic lesions detected in the colon, nor in the other abdominal organs by colonoscopy and ultrasound sonography.

We compared the SUV between FDG-PET true positives (two subjects) and FDG-PET false positives (22 subjects). The mean ± s.d. of the SUVs was 4.9 ± 1.46 in true positives and 4.5 ± 0.96 in false positives, and there was no significant difference between them.

DISCUSSION

We have shown that the sensitivity of FDG-PET for gastric cancer is as low as 10% in this study. Although the sensitivity of FDG-PET for gastric cancer has been reported in some studies to range from 60 to 94% (Yeung *et al*, 1998; De Potter *et al*, 2002; Stahl *et al*, 2003; Yoshioka *et al*, 2003; Mochiki *et al*, 2004; Chen *et al*, 2005; Yun *et al*, 2005), the subjects used in those reports were primarily clinically diagnosed, preoperative, advanced cancer, or recurrent cancer cases, and thus the sensitivity values calculated in those studies may not represent screening sensitivity. Screening sensitivity can only be measured in an asymptomatic population, preferably by performing diagnostic examination such as endoscopy on all subjects in order to identify cancer subjects in the population. There have been no other studies that have evaluated the sensitivity of FDG-PET for gastric cancer in an asymptomatic population based on the findings of endoscopy as the gold standard.

There are a few issues to be addressed, which might have influenced the sensitivity calculated in this study. Firstly, our case series of screen-detected cancers consists largely of cancers in the early stages, and the proportion of more advanced cancers was very small (2 of 20) (Table 2). Our previous report showed a little higher detection rate of gastric cancer in men than expected, which suggested possible overdiagnosis among screen-detected cancers (Hamashima *et al*, 2006). The high proportion of early cancers, including those of overdiagnosis among screen-detected cancers, could be a reason for our low sensitivity. There is one study from Japan in which the sensitivity of FDG-PET for early gastric cancer could be calculated, although the subjects used were clinically diagnosed cancers. Mochiki *et al* (2004) reported that the sensitivity was 40% in gastric cancers of T1 stage subsequently treated surgically. Although detailed information on the depth of cancer invasion was not available in that paper, the case series in their report was estimated to be of a more invasive nature than those in the present study in terms of depth of invasion. Because the indication for surgical resection of gastric cancer in terms of depth of cancer invasion is submucosal or deeper invasion in Japan, the subjects with T1. stage cancers would have had submucosal invasion in their study. In the present study, 12 out of 18 T1 cancers were intramucosal cancer, which did not necessarily require surgery. This difference might explain the difference in sensitivity for early cancer detection between the two studies. However, even when intramucosal cancers were excluded from the calculation, the sensitivity was only 12.5% (one positive out of eight). Secondly, in our study, we performed chromoendoscopy on all screenees, which might have enhanced the ability to detect small cancer lesions. Thirty percent of cancer lesions were 10 mm or less in diameter (Table 1). In any case, the calculated sensitivity in this study might be underestimated due to potential overdiagnosis relevant to screen-detected cancer as mentioned above.

The FDG-PET procedure employed in this study is based on the standard method used in clinical practice, except for the criteria for assessment of cancer. PET findings were assessed according to the criteria, which we defined, due to lack of established criteria. The main difficulty in FDG-PET diagnosis of stomach cancer is physiological uptake in the stomach (Cook *et al*, 1996; Gordon *et al*, 1997; Shreve *et al*, 1999; Koga *et al*, 2003), but there was no cancer subject in whom we had difficulty in differentiating physiological uptake from cancer lesions. Nevertheless, it is possible that there were tiny cancers overlooked due to significant FDG background uptake. As physiological uptake is more significant in the oral end of the stomach than in the anal end, screen-detected cancers with FDG-PET might be biased towards cancers in the anal end of the stomach.

In this study, there were 22 subjects with false-positive PET. There remains the possibility that upper gastrointestinal endoscopy had overlooked tiny lesions rather than that they were false positives. However, endoscopic images recorded in as many as approximately 50 shots were reviewed just after endoscopy to check for overlooked lesions. Therefore, it is unlikely that overlooked lesions were a main reason for such a low sensitivity.

It might be necessary to compare FDG-PET findings with those of existing examinations, such as barium meal and gastrointestinal endoscopy in terms of efficacy, cost, convenience, and radiation dose. Efficacy has been evaluated only for barium meal examinations in Japan by case-control studies (Oshima *et al*, 1986; Fukao *et al*, 1995; Mizoue *et al*, 2003). ^{18}F-2-deoxy-2-fluoro-glucose Positron Emission Tomography is more expensive than the other two procedures (85 000 Japanese yen or 772 US$ for FDG-PET, 12 680 yen or 115 US$ for endoscopy in our screening program, and about 82 US$ for barium meal examination). There is much less inconvenience for screenees with FDG-PET than is seen after endoscopy or barium meal examination, which are often accompanied by discomfort during examination, side effects of antispasmodic agents, or constipation after examination. With regard to radiation dose, the average dose at our facility during the current study was 3.2 mSv for FDG-PET and 4.4 mSv for CT, which are similar to prior reports of barium meal examination that ranged from 3.0 to 9.3 mSv (Broadhead *et al*, 1995; Geleijns *et al*, 1998), although the radiation dose of screening fluorography in Japan would be lower than barium meal examination as a diagnostic test (Kato *et al*, 1999).

This study did not evaluate the efficacy of FDG-PET screening for gastric cancer. Moreover, in this study, the sensitivity for more advanced cancers, which would be less likely to be affected by overdiagnosis, could not be measured due to an insufficient number of such cancers among screen-detected cancers. The sensitivity calculated here might thus be an underestimate of that for all gastric cancers. However, in conclusion, it was clearly demonstrated in this study that FDG-PET is poorly sensitive for the detection of gastric cancer in the early stages.

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便潜血検査による大腸がん検診

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はじめに

大腸がん検診というと専門病院で多くの医師や看護師に囲まれ，痛くつらくまた少々恥ずかしい検査を受けることを想像する方が多いのではなかろうか。しかし，そうではない。自宅で簡単にできる便潜血検査こそ，まず受けるべき大腸がん検診の検査法である。厚生労働省の研究班は平成16年に大腸がん検診のガイドラインを示し，「便潜血検査を用いた大腸がん検診は，大腸がん死亡減少効果を示す十分な証拠があるので実施することを強く勧める」と勧告した[1]。しかし，大阪府における便潜血検査による大腸がん検診の受診率は平成16年度の統計で11.0％と低い[2]。がん検診に対する正しい知識の啓発，受診機会の拡大，精度の高い検診の提供など，受診率を向上させるためのさらなる施策が必要である[3]。本論文ではわが国における大腸がん検診の概要を述べる。これを機会に大腸がん検診に理解を深めていただき，受診率向上にお力添えをいただければ幸いである。

(1) 大腸がんについて

大腸がんの動向

大腸がんは日本人で最も増加傾向が著しいがんの一つであったが，年齢調整死亡率はここ10年横ばいないし若干低下傾向に変わったとされる[4]。しかし，平成16年のわが国の大腸がん死亡数は約４万人，悪性新生物死亡全体に占める割合は男性11.3％，女性14.3％。がん死亡順位は男性で肺，胃，肝について４位，女性で全てのがん中１位であり[4]，国民の健康保持にとって大腸がん対策は大きな課題であることに変わりはない。

がんと新たに診断された人の数をがん罹患数という。死亡数については死亡診断書を用いた全国的な統計があるが，罹患数については全国的な統計がないため，全国の罹患数はがん登録を行っている府県や市の成績から推計されている。このような研究によれば，平成10年の全国大腸がん罹患数の推計値は約11万人，罹患順位は男性では胃，肺に次いで３位，女性でも乳房，胃に次いで３位であった[5]。平成７年頃を境に大腸がん罹患率も増加傾向に歯止めがかかり低下傾向に変わったのではないかとの報告が最近大阪府がん登録よりなされた[6]。これががん予防活動の成果であれば喜ばしい。今後の研究結果が待たれる。

大腸がん罹患のリスク

がんは生活習慣病の一つである。特に大腸がんは種々の生活習慣に敏感に反応し増減すると考えられる。日本がん疫学研究会の「がん予防指針検討委員会」によれば，大腸がんのリスク要因としてほぼ確実と判定されたものに運動不足があり，可能性があると判定された物に多量飲酒，油脂・肉類の多食，喫煙，塩分多食がある。逆に大腸がんの危険を下げるものとして，ほぼ確実と判定されたものに野菜や果物の十分な摂取があり，予防要因の可能性があるとされたものに黄緑色野菜の摂取，豆・穀物・海草など食物繊維を含む食品の摂取がある[7]。禁煙，節酒，運動，塩分を控えた和食中心の食生活を維持し定期検診を受けることは，大腸がんの予防のみならずメタボリック症候群の予防にも役立ち，今後益々重要である。

大腸がんの症状

大腸がんは，早期がんから進行がんへ進行する。早期がんはポリープ（腺腫）から発生するものと，正常の粘膜から発生するものがある。大腸がんは

内視鏡検査の偶発症

検診に伴う不利益として精密検査や治療時における医療事故がある。消化器内視鏡学会の全国調査は，内視鏡検査前の鎮静剤や鎮痛剤などの前処置による偶発症が0.0059％に，うち死亡事故が0.00010％に発生した。加えて穿孔など大腸内視鏡検査による偶発症が0.069％に，うち死亡事故は0.00088％発生した[16]と報告した。検査を受ける前は検査の危険性と事故の対策について十分な説明を受け，同意した上で検査を受けるべきである。

(4) がん検診の評価

がん検診の評価方法

がん検診を行うと早期のがんが多く発見されたり，発見されたがん患者の生存率の上昇が観察されたりする。しかし，これだけでは検診の効果があったとは評価できない。なぜなら，検診の効果がなくても，見かけ上そのような現象が観察されることが知られているからである[17-20]。

例えば，検診では早期にがんを発見できる。このため発見から死亡までの期間が延長する。実際には検診の効果がなく，「検診を受けても受けなくても死亡する年齢は変わらなかった」としても，見かけ上生存率が高くなる。また逆に，検診で発見されるがんは，「治療しなくてもそれ以上進行せず，放置してもそのがんで死亡することはなかった」かも知れない。つまり検診は余計な検査や治療をしただけ，との想定も可能である[21]。このような場合，発見率は高くなり，生存率も高くなる。これも見かけ上の効果である。

このような影響を避け検診の効果を正確に評価するには，「検診がそのがんの死亡を実際に減少させている」ことを，直接証明する必要がある。

検診による死亡減少を証明するにもいくつかの方法があり，その方法により結果に対する信頼性は異なる。現在最も信頼性が高いとされているのは「無作為割り付け試験」と呼ばれるものである。

当初，計画に則って研究参加者を募り，検診を行う群と行わない群に分け登録する。検診実施群にのみ検診を実施し，その後両群の死亡状況を何年にも渡り追跡する。検診を行った群での死亡が，検診を受けなかった群に比べ低下すれば，検診の効果があったと評価できる。両群で年齢や人種，性別など，検診の効果に影響を及ぼすと想定される因子の影響を除くため，参加者を無作為にどちらかの群に振り分ける必要があることから，「くじ引き試験」とも呼ばれる。

この他，「症例対象研究」と呼ばれる方法がある。これは，ある地域または集団でそのがんで死亡した人を漏れなく把握し，遡って検診を受けていたかどうかで死亡に差があるかをみる研究である。「無作為割り付け試験」に比べると比較的簡単に行え，結果に対する信頼性は「無作為割り付け試験」に次いで高い。

大腸がん検診の死亡率減少効果

大腸がん検診は大腸がん死亡を減少させるのであろうか。世界では三つの無作為化比較対照試験が行われ，いずれも有意な大腸がん死亡率減少効果を認めている。米国のマンデルらはミネソタ州の50-80歳の男女ボランティアを逐年検診受診群1万5,570人，隔年検診受診群1万5,587人と非検診群1万5,394人に分け，18年間両群における大腸がん死亡を追跡調査した。大腸がん死亡のリスクは隔年検診群で0.79（95％CI0.62-0.97），逐年検診群で0.67（95％CI0.51-0.83）と減少し有意差があった[22]。英国ノッチンガムやデンマークでも同様の無作為化比較対照研究が行われ，いずれも有意な大腸がん死亡減少効果を認めた[23-24]。

平成16年，厚生労働省の研究班は内外の文献を系統的にレビューし「有効性評価に基づく大腸がん検診ガイドライン」を発刊した。この中で大腸がん検診の効果については「死亡率減少効果を証明する十分な証拠がある」と評価した[1]。便潜血検査による大腸がん検診は，マンモグラフィを用いた乳がん検診と並び，人間を対象とした大規模な実験的研究で効果が認められた数少ないがん検診で，有効性についての証明は折り紙付きといえる。

(5) 大腸がん検診の現状と精度管理

集団検診と個別検診

がん検診は何処で受診すればよいのであろうか。以前，老人保健法は市町村にがん検診の実施を義務づけていた。このため，現在でもほとんどの自

治体が，がん検診を行っている。職場や人間ドックで検診を受ける機会のない方は，自治体のがん検診を利用するとよい。自治体の検診には，市町村の保健センターや検診車で行う集団検診方式と，自治体と契約した医院や病院で行う個別検診方式がある。個別検診方式は採用している自治体と採用していない自治体がある。詳しくは自治体の広報紙をみたり担当課にお問い合わせいただきたい。

検診受診率

消化器がん検診学会の全国集計調査によれば，平成16年度に報告された全国の大腸がん検診の総受診者数は392万人であった[25]。

がん検診を実施主体別にみると，自治体が行う地域検診，会社や健康保険組合が行う職域検診，個人や対がん協会員などが医療機関で受けるその他の検診がある。検診場所でみると，検診車や施設を利用して行う集団検診方式と，指定医療機関で行う個別検診方式がある。

平成16年度の大阪府の市町村が行う大腸がん検診の対象者数は約260万人，うち受診者数は28万6千人，大腸がん検診受診率は11.0％であった。このうち27.3％が集団検診方式で，72.2％が個別検診方式で受診していた。受診率を市町村別にみると，最高37.9％から最低2.5％まで大きなばらつきがあった[2]。老人保健法でがん検診の実施が市町村に義務づけられていた時代と違い，今や，市町村にとってがん検診の拡大は，財政的負担をもたらすだけであまり他にメリットがないともいわれ[3]，受診率向上策は大きな政策的課題でもある。

精度管理

がん検診の水準を高く一定に保つためには，その信頼性を検証し，問題を見つけそれを改善するシステムが必要である。これを精度管理と呼ぶ。精度管理のしっかりした体制をもつ検診は信頼性が高い[25]。

がん検診の信頼性を測る尺度として精度管理指標がある。これには，要精検率，精検受診率，がん発見率，早期がんの割合などがある。これらの指標が全体として良好な成績の検診が，精度の高いがん検診といえる。ただし，受診者数が少ない検診の成績は，偶然に左右される可能性が高いので，解釈には注意が必要である。

要精検率

全受診者中精密検査が必要と判定された人の割合である。成績は検査キットの種類や採便後の便の保存状況などに左右される。検査の精度を評価する指標の一つで，高すぎても低すぎても検査精度に疑問が持たれる。平成16年度の消化器がん検診学会の全国調査では大腸がん検診の要精検率は平均５～６％であった[25]。

精検受診率

精検受診率は精密検査が必要と判定されたなかで実際に精密検査を受けた人の割合である。受診率という言葉で検診受診率と混同しないよう注意が必要である。精度の高い検診を行うには，精密検査を受けていない人に受診を勧める受診勧奨のシステムがうまく機能する必要がある。精検受診率は高ければ高いほど精度が高く精度管理の指標として信頼性が高い。なお，大腸がん検診では便潜血検査の再検査は精密検査の方法として認められておらず，精検受診者数に含まれていない。

がん発見率

がん発見率は全受診者中発見されたがん患者数の割合である。がん発見率があまり低いとがんを見逃している可能性があり精度の低い検診といえる。ただしこれは受診者の性・年齢構成に左右される。がん発見率は女より男で高く，高齢の受診者の割合が多いほど高くなる。すなわち正確にはがん発見率は性・年齢階級毎に比較する必要がある。ただ少人数の集団では細かく区分けすると成績が安定しないので，これを補正するため全国集計の成績を基準とした標準化発見比を計算するなどの工夫がある[2]。

早期がんの割合

全発見がん中の早期がんの割合である。これが低いと検査の判定，あるいは精密検査の診断能力に問題がある可能性が高い。なおこの成績は，初めて検診を受ける初回受診者の割合が多いと悪くなるので，解釈時には注意が必要である。

平成16年度消化器がん検診学会全国集計，大腸がん検診の成績

	受診者数	要精検率	精検受診率	発見大腸がん数 がん発見率
地域検診	2,285,466人	149,038人 6.5%	104,992人 70.4%	4,171人 0.183%
職域検診	1,435,635人	73,459人 5.1%	29,000人 39.5%	667人 0.046%
個人検診	196,333人	12,464人 6.3%	6,547人 52.5%	224人 0.124%

平成16年度大阪府内市町村が実施した大腸がん検診の成績

	受診者数	要精検率	精検受診率	発見大腸がん数 がん発見率	うち早期がん数 早期がん発見率
地域検診 集団検診方式	78,049人	4,969人 6.4%	3,515人 70.7%	184人 0.24%	128人 0.16%
地域検診 個別検診方式	208,337人	17,250人 8.3%	8,048人 46.7%	475人 0.23%	192人 0.09%

平成16年度大阪がん予防検診センターが実施した大腸がん検診の成績

	受診者数	要精検率	精検受診率	発見大腸がん数 がん発見率
地域検診 集団検診方式	27,450人	1,695人 6.2%	1,260人 74.3%	80人 0.29%

精度管理の実際

表１に平成16年度の消化器がん検診学会の全国調査の成績[25]を，表２に大阪府内の市町村が行った大腸がん検診の成績[2]を，表３に大阪がん予防検診センターが行った大腸がん検診の成績[2]を示した。なお，大阪がん予防検診センターの成績は，大阪府地域検診集団検診方式の成績の一部である。全国的にみると，市町村が行う地域検診の成績は，職域検診や人間ドックなどで行う個人検診の成績より良好で精度が高いと言える。大阪府の地域検診の成績では，集団検診方式の成績が個別検診方式の成績より良好で精度が高いと言える。大阪がん予防検診センターの成績は，全国集計の成績や大阪府下市町村の成績より良好で最も精度が高いことが分かる。

現在ではインターネット等でこのような精度管理指標を発表している機関もあり，一般の方でも比較的簡単にこれらの成績を知ることができるようになってきた。受診される方も，このようなしくみや成績に興味を持たれ，精度の高い検診を選ばれるとよい。

治療成績

平成16年度の消化器がん検診学会の全国調査では治療法の判明した発見がん3,577例中，内視鏡下切除を受けたもの46%，腹腔鏡下手術を受けたもの７%，開腹手術を受けたのもの45%であった[25]。

平成16年度の大阪府における地域検診では発見がん659例中治療を受けたと判明したもの570例。うち内視鏡下切除は203例，35.6%で行われていた。ポリープは4,322人に発見されうち1,708例(40%)で内視鏡的切除が行われていた。このうち病理検査でがんと判明したのは75例(1.7%)であった。これは内視鏡切除203例に含まれる。ポリープの内視鏡治療の必要性を示す結果といえるが，しかし一方，ポリープのなかでがんは２%以下であり，ポリープといわれてもあまり慌てたり心配しすぎたりする必要がないことを示す結果ともいえる。

おわりに

大腸がんは早期に発見されると予後が良好であり，早期発見には検診が唯一の手段である。便潜

血検査を用いた大腸がん検診は，大腸がん死亡減少効果をもつ有効ながん検診であることが国際的に認められている。検診には自治体や会社が行う集団検診と医療機関や人間ドックで行う個別検診がある。大腸がん検診の受診率はまだ低く大阪府の統計では11％であった。40歳以上の方は男女を問わず，毎年，免疫学的便潜血検査二日法を受けるようお勧めする。検診により便潜血陽性と判定されたら必ず精密検査を受けることが必要である。大腸がんの治療法は進歩し早期に発見されて内視鏡治療で完治するものも増えている。大腸がんを予防するために，是非ご自身でも検診をお受けになるとともに，家族の方や周囲の方にも受診を勧めていただきたい。

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「大腸癌」と「大腸がん検診」について

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【要 旨】
大腸癌は、近年、わが国において死亡率が著しく増加している疾患の一つであり、その大きな要因として高脂肪食や高蛋白食、低線維成分食など食生活の西洋化が推測されている。
大腸癌は比較的予後のよい癌の一つとして挙げてもよいが、進行してしまえば、致命的となることはすべての癌に共通することであり、特に、大腸癌では早期発見・早期治療が強く望まれる所以である。
その様な情勢の中で、大腸癌は進行癌であっても無症状で発見できれば、予後が期待できる疾患であり、わが国における二次予防としての大腸がん検診は精度管理がしっかりしていれば、その効果が十分に期待できる事業である。
本稿では、まず、わが国における大腸癌診療の現況を、診断、治療、治療後の指導の面から概説した。また、大腸がん検診の現況を、受診率、要精検率、精検受診率、がん発見率、および陽性適中度について述べた。
大腸がん検診の効率よい実施のためには国民を含めた行政、医療機関による精度管理の向上が重要課題である。

はじめに

大腸癌は大腸すなわち直腸、結腸および盲腸の上皮性悪性腫瘍であり、原発性と続発性に分けられる。原発性大腸癌は組織学的には比較的予後のよい高分化型腺癌が多いのが特徴的である。続発性大腸癌は他臓器の癌が浸潤・転移したものであり終末期癌のことが多く、がん検診においては馴染みのない疾患である。そこで、本稿では原発性大腸癌について、特にがん検診の面から記述したい。

Ⅰ わが国における大腸癌診療の現況

大腸癌は、近年、わが国において死亡率が著しく増加している疾患の一つであり（図1）、その大きな要因として高脂肪食や高蛋白食、低線維成分食など食生活の西洋化が推測されている。

大腸癌は比較的予後のよい癌の一つとして挙

図1.部位別悪性新生物死亡率の推移