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Original Article

Socioeconomic Status and Cancer Screening in Japanese Males: Large Inequlaity in Middle-Aged and Urban Residents

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Abstract

Objectives: Cancer screening has become common in Japan. However, little is known about the socioeconomic factors affecting cancer screening participation. This study was performed to examine the association between socioeconomic status and cancer screening participation in Japanese males.

Methods: Using the data of 23,394 males sampled from across Japan, the associations between self-reported participation in screenings for three types of cancer (*i.e.*, stomach, lung and colon) and socioeconomic variables, including marital status, types of residential area (metropolitan/nonmetropolitan), household income, and employment status, were examined using multilevel logistic regression by age group (40 to 64 and ≥65 years).

Results: The cancer screening participation rates were 34.5% (stomach), 21.3% (lung), and 24.8% (colon) for the total population studied. Being married, living in a nonmetropolitan area, having a higher income and being employed in a large-scale company showed independent associations with a higher rate of cancer screening participation for all three types of cancer. Income-related differences in cancer screening were more pronounced in the middle-aged population than in the elderly population, and in metropolitan areas than in nonmetropolitan areas.

Conclusions: There are notable socioeconomic differences in cancer screening participation in Japan. To promote cancer screening, socioeconomic factors should be considered, particularly for middle-aged and urban residents.

Key words: cancer screening, health inequality, socioeconomic factor, urban health

Introduction

There is considerable inequality in health with regard to socioeconomic status, and the elimination of health inequality is an important public health concern (1). Socioeconomic inequality has been confirmed to be associated with not only mortality, morbidity, and health-related behavior, but also access to and the utilization of health services, including cancer screening (1–3). Lower socioeconomic status in terms of income and education level inhibit participation in cancer screenings, in combination with marital status, health insurance coverage status, type of residential area, ethnicity, and other factors (4–10).

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Cancer screening is mainly carried out in three settings in Japan. First, cancer screening programs in communities have been encouraged by the Health Law for the Elderly since 1983 (11, 12). Screenings for stomach, lung, uterine cervical, breast, and colon cancers are offered to community residents, generally to those aged over 40 years, by local municipal governments, with or without a small copayment (11, 13). Second, a multiphasic health check-up program is provided in the workplace, which includes cancer screening in addition to an obligatory annual health check-up (14, 15). Last, people can also receive preventive health programs at their own expense at hospitals and clinics. A typical program is the so-called "Ningen Dock", which is a comprehensive program for cardiovascular disease, cancer, and other disorders. Health insurance organizations encourage the insured to participate in these programs, which are not covered by insurance benefits, with some financial support.

Thus, there are various opportunities to participate in cancer screenings in Japan, with minimal financial concern.

However, little is known about how these various opportunities influence socioeconomic differences in cancer screening participation. In this study, we examined the associations between cancer screening participation and individual socioeconomic variables, including marital status, type of residential area, household income, and employment status, in Japanese males.

Methods

Data from the 2001 Comprehensive Survey of the Living Conditions of People on Health and Welfare by the Ministry of Health, Labour and Welfare were used (16). This survey involved interviewing all household members within 5240 area units of stratified random samples from across the country (16). It contained questions to obtain basic information on household and individual characteristics regarding demographics, health, illness profiles, lifestyle, and others. The total number of households participating in the basic information survey was 247,195. Of them, 30,386 households were selected at random and interviewed regarding income and savings. Consequently, both basic information and income information were available for only these 30,386 households; in this study, we analyzed the data of 23,394 males aged over 40 years from these households. The response rate was 87.3% for the basic information survey and 79.5% for the income survey (16). Microdata files (digitalized files of individual records) from this survey were used with permission from the Ministry of Internal Affairs and Communication.

Participation in cancer screening for stomach, lung, and colon cancers in the past year was surveyed by the interviewers. In this survey, cancer screening included all types of examination, provider and setting and the type of examination was not specified (*e.g.*, "Have you participated in a cancer screening for stomach cancer, for example, a community mass screening, a regular health check-up or Ningen Dock, in the past 12 months?").

We used age, marital status, type of residential area, employment status, and household income as socioeconomic variables. Marital status was divided into married and others (*i.e.*, never married, separated or divorced).

The type of residential area was categorized as metropolitan or nonmetropolitan. The 23 special wards of Tokyo and 12 metropolitan cities (*i.e.*, Sapporo, Sendai, Chiba, Yokohama, Kawasaki, Nagoya, Kyoto, Osaka, Kobe, Hiroshima, Kitakyushu and Fukuoka) were defined as metropolitan areas.

We used information on annual household income before tax, including benefits and transfer payments. To adjust for family size and composition, we used the modified OECD (Organization for Economic Cooperation and Development) equivalence scale of 1.0 for the first adult, 0.5 for the second and each subsequent person aged 14 and over, and 0.3 for each child aged under 14 (17). The study subjects were categorized into quintiles according to household income. The quintile categorization was conducted by age group: middle-aged group (aged 40 to 64 years) and elderly group (aged ≥65 years).

Employment status was based on the size of the company in which the subjects were employed, because the occupational and preventive health services provided strongly depend on company size (14, 18, 19). Employment status was divided into the following five categories: self-employment or employment in a small-scale company with fewer than 30 employees, employment in a medium-scale company with 30 to 999 employees, employment in a large-scale company with more than 1000 employees or a government office, not working, and others. 'Not working' included people performing housework, students, and the unemployed and retired. 'Others' consisted of officers of companies or organizations, part-time workers and unspecified workers.

Multilevel logistic regression analysis with individuals (level 1) nested in 47 prefectures (level 2) was used to calculate the adjusted odds ratio (OR) and 95% confidence interval (CI) of independent variables for participation in cancer screenings with two models. In model 1, age, marital status, type of residential area and income were assigned as independent variables. In model 2, employment status was added to the analysis as an independent variable. These analyses were conducted separately for the middle-aged and elderly groups. To compare the influence of income on cancer screening participation between metropolitan and nonmetropolitan areas, model 2 was conducted by residential area for the middle-aged group. The differences in the influences of income on screening by age group and residential area were examined using interaction terms in which income quintiles were dealt with as continuous variables. The statistical package MLwiN 1.10 (Centre for Multilevel Modelling, Institute of Education, University of London, London) was used for the analyses, and the Iterative Generalized Least Squares (IGLS) method was applied to estimate coefficients (20).

Results

Table 1 shows the socioeconomic characteristics of the study subjects by age group. The cancer screening participation rates of the total population were 34.5% for stomach cancer, 21.3% for lung cancer and 24.8% for colon cancer. The participation rates by socioeconomic characteristics are shown in Table 2. The participation rate of subjects who were married and living in a nonmetropolitan area was higher than those of the other groups. Marked gradients in participation rate according to income quintile were found for all types of cancer. Employment in a large-scale company showed the highest participation rate, followed by employment in a medium-scale company.

Table 3 shows the adjusted ORs for participation in screening for stomach cancer. In model 1, others for marital status and living in a metropolitan area showed significantly lower odds of cancer screening participation than being married and living in a nonmetropolitan area, respectively, for both age groups. Although a gradient in OR according to income quintile was found for both age groups, the gradient for the middle-aged group was steeper than that for the elderly group. In model 2, in which employment status was included as an independent variable, employment in a medium- or large-scale company showed significantly higher odds than self-employment or employment in a small-scale company for the middle-aged group. The gradient in OR according to income

Table 1 Socioeconomic characteristics of study subjects by age group

Variable	40–64 years	≥65 years
	N (%)	N (%)
Marital status[a]		
Married	13,120 (86.3)	7,117 (86.9)
Others	2,086 (13.7)	1,071 (13.1)
Residential area[b]		
Nonmetropolitan area	13,244 (87.1)	7,193 (87.8)
Metropolitan area	1,962 (12.9)	995 (12.2)
Income (median: thousand yen)		
1st quintile (lowest)	1,249	973
2nd quintile	2,250	1,747
3rd quintile	3,120	2,397
4th quintile	4,190	3,133
5th quintile (highest)	6,464	4,833
Employment status[c]		
Self-employed/small scale	5,602 (36.8)	2,131 (26.0)
Medium scale	3,743 (24.6)	157 (1.9)
Large scale	2,952 (19.4)	46 (0.6)
Not working	1,152 (7.6)	4,882 (59.6)
Others	1,757 (11.6)	972 (11.9)

[a] Others includes never married, separated, and divorced.
[b] Metropolitan area includes 23 special wards of Tokyo and 12 ordinance-designated cities.
[c] Self-employed/small scale: self-employed or an employee of a company with fewer than 30 employees; medium scale: employee in a company with 30 to 999 employees; large-scale: employee in a company with at least 1000 employees.

Table 2 Participation in cancer screening by socioeconomic characteristics

	Stomach cancer	Lung cancer	Colon cancer
	N (%)	N (%)	N (%)
Age (years)			
40–64	5,231 (35.1)	3,201 (21.4)	3,719 (24.9)
≥65	2,658 (33.5)	1,677 (21.1)	1,957 (24.7)
Marital status[a]			
Married	7,171 (36.2)	4,414 (22.3)	5,216 (26.3)
Others	718 (23.5)	464 (15.2)	460 (15.1)
Residential area[b]			
Nonmetropolitan area	7,061 (35.4)	4,426 (22.2)	5,097 (25.6)
Metropolitan area	828 (28.7)	452 (15.6)	579 (19.8)
Income			
1st quintile (lowest)	1,080 (23.9)	683 (15.1)	754 (16.7)
2nd quintile	1,336 (29.3)	879 (19.3)	984 (21.6)
3rd quintile	1.619 (35.4)	1,017 (22.2)	1,227 (26.8)
4th quintile	1,733 (37.8)	1,063 (23.2)	1,241 (27.1)
5th quintile (highest)	2,118 (45.9)	1,234 (26.8)	1,467 (31.8)
Employment status[c]			
Self-employed/small scale	2,210 (29.3)	1,434 (19.0)	1,585 (21.0)
Medium scale	1,463 (38.2)	872 (22.8)	1,013 (26.4)
Large scale	1,514 (51.1)	897 (30.3)	1,081 (36.5)
Not working	1,744 (29.9)	1,084 (18.6)	1,310 (22.5)
Others	958 (35.9)	591 (22.2)	687 (25.7)

[a] Others includes never married, separated, and divorced.
[b] Metropolitan area includes 23 special wards of Tokyo and 12 ordinance-designated cities.
[c] Self-employed/small scale: self-employed or an employee of a company with fewer than 30 employees; medium scale: employee in a company with 30 to 999 employees; large scale: employee in a company with at least 1000 employees.

quintile in model 2 for the middle-aged group was moderate compared with that in model 1.

Tables 4 and 5 show the adjusted ORs for participation in screening for lung and colon cancers, respectively. Similar tendencies to those observed for stomach cancer screening were found: others for marital status and living in a metropolitan area showed lower odds; higher income and employment in a medium- or large-scale company showed higher odds; and the gradient in OR according to income quintile was steeper for the middle-aged group than that for the elderly group. For lung cancer screening participation in the elderly group, the odds of the 2nd quintile was not significantly higher compared with that of the 1st quintile, and the odds of the 3rd, 4th and 5th quintiles did not differ significantly.

As for the interaction between income and age group, model 1 (without employment status) of stomach and colon cancers and model 2 (with employment status) of stomach cancer showed significant ($p<0.05$) negative coefficients for the interaction terms (data not shown). These findings indicate that income-related differences in cancer screening participation rates were significantly smaller in the elderly group than in the middle-aged group.

The adjusted ORs according to income quintile for cancer screening participation by residential area for the middle-aged group are shown in Table 6. The gradient in OR was steeper for metropolitan areas than for non-metropolitan areas. The interaction terms of income and residential area showed significant ($p<0.05$) coefficients for all types of cancer, indicating that the effects of income on cancer screening participation differed significantly according to the type of residential area: the impact of income in metropolitan areas was stronger than that in nonmetropolitan areas.

Discussion

Using a large sample from across the country, this study showed that socioeconomic status, particularly income, is significantly associated with the rate of cancer screening participation. There are a few plausible explanations for the association between income and cancer screening participation, in addition to the economic barrier.

First, socioeconomic status influences health-related behavior through health knowledge and attitudes. It is possible that inadequate knowledge of and poor attitudes toward health in people with a lower income (21–23) deter participation in cancer screenings, even if such people have the opportunity to participate.

Second, previous studies demonstrated that lack of time and inconvenience were common reasons for notparticipating in cancer screenings (24, 25), and that improving screening convenience, for example, by holding early morning and weekend screenings, is associated with an increased participation rate (26). Lack of time and indirect costs of participation seem to be plausible reasons for nonparticipation among people of

Table 3 Adjusted odds ratios (ORs) with 95% confidence intervals (CIs) for participation in screening for stomach cancer in Japanese males aged 45–64 and those aged ≥65 years

Socioeconomic variable	Model 1[a]		Model 2[a]	
	45–64	≥65	45-64	≥65
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Marital status[b]				
Married	1.00	1.00	1.00	1.00
Others	0.58 (0.52, 0.65)	0.72 (0.60, 0.85)	0.62 (0.52, 0.73)	0.72 (0.62, 0.85)
Residential area[c]				
Nonmetropolitan area	1.00	1.00	1.00	1.00
Metropolitan area	0.85 (0.75, 0.97)	0.78 (0.64, 0.95)	0.85 (0.74, 0.96)	0.79 (0.66, 0.94)
Income				
1st quintile (lowest)	1.00	1.00	1.00	1.00
2nd quintile	1.40 (1.24, 1.58)	1.12 (0.94, 1.34)	1.30 (1.15, 1.47)	1.13 (0.96, 1.32)
3rd quintile	1.75 (1.56, 1.97)	1.48 (1.24, 1.75)	1.44 (1.28, 1.63)	1.49 (1.28, 1.74)
4th quintile	2.39 (2.13, 2.69)	1.50 (1.26, 1.78)	1.82 (1.62, 2.06)	1.50 (1.28, 1.75)
5th quintile (highest)	3.44 (3.06, 3.86)	1.80 (1.51, 2.14)	2.45 (2.17, 2.76)	1.75 (1.50, 2.05)
Employment status[d]				
Self-employed/small scale			1.00	1.00
Medium scale			1.71 (1.56, 1.88)	0.83 (0.58, 1.17)
Large scale			2.60 (2.34, 2.88)	2.03 (1.09, 3.78)
Not working			1.13 (0.97, 1.32)	0.82 (0.78, 0.92)
Others			1.40 (1.24, 1.58)	0.95 (0.81, 1.12)

[a] Model 1: The independent variables are age, marital status, residential area, and income; model 2: the independent variables are age, marital status, residential area, income, and employment status.
[b] Others includes never married, separated, and divorced.
[c] Metropolitan area includes 23 special wards of Tokyo and 12 ordinance-designated cities.
[d] Self-employed/small scale: self-employed or employee of a company with fewer than 30 employees; medium scale: employee in a company with 30 to 999 employees; large scale: employee in a company with at least 1000 employees.

Table 4 Adjusted odds ratios (ORs) with 95% confidence intervals (CIs) for participation in screening for lung cancer in Japanese males aged 45–64 and those aged ≥65 years

Socioeconomic variable	Model 1[a]		Model 2[a]	
	45–64	≥65	45–64	≥65
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Marital status[b]				
Married	1.00	1.00	1.00	1.00
Others	0.68 (0.58, 0.76)	0.70 (0.58, 0.84)	0.70 (0.62, 0.80)	0.71 (0.59, 0.85)
Residential area[c]				
Nonmetropolitan area	1.00	1.00	1.00	1.00
Metropolitan area	0.77 (0.66, 0.89)	0.74 (0.60, 0.92)	0.76 (0.65, 0.88)	0.73 (0.59, 0.90)
Income				
1st quintile (lowest)	1.00	1.00	1.00	1.00
2nd quintile	1.40 (1.21, 1.60)	1.16 (0.96, 1.40)	1.32 (1.15, 1.53)	1.16 (0.97, 1.40)
3rd quintile	1.61 (1.41, 1.85)	1.55 (1.30, 1.86)	1.41 (1.22, 1.62)	1.57 (1.32, 1.88)
4th quintile	2.01 (1.76, 2.30)	1.48 (1.24, 1.78)	1.66 (1.44, 1.91)	1.48 (1.24, 1.78)
5th quintile (highest)	2.45 (2.14, 2.80)	1.55 (1.30, 1.86)	1.91 (1.66, 2.20)	1.53 (1.27, 1.83)
Employment status[d]				
Self-employed/small scale			1.00	1.00
Medium scale			1.38 (1.24, 1.54)	0.61 (0.39, 0.94)
Large scale			1.87 (1.66, 2.10)	1.44 (0.75, 2.75)
Not working			0.97 (0.81, 1.17)	0.85 (0.74, 0.96)
Others			1.30 (1.13, 1.49)	0.97 (0.81, 1.17)

[a] Model 1: The independent variables are age, marital status, residential area, and income; model 2: the independent variables are age, marital status, residential area, income, and employment status.
[b] Others includes never married, separated, and divorced.
[c] Metropolitan area includes 23 special wards of Tokyo and 12 ordinance-designated cities.
[d] Self-employed/small scale: self-employed or employee of a company with fewer than 30 employees; medium scale: employee in a company with 30 to 999 employees; large scale: employee in a company with at least 1000 employees.

Table 5 Adjusted odds ratios (ORs) with 95% confidence intervals (CIs) for participation in screening for colon cancer in Japanese males aged 45–64 and those aged ≥65 years

Socioeconomic variable	Model 1[a]		Model 2[a]	
	45–64	≥65	45–64	≥65
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Marital status[b]				
Married	1.00	1.00	1.00	1.00
Others	0.51 (0.45, 0.59)	0.69 (0.58, 0.83)	0.54 (0.47, 0.62)	0.69 (0.58, 0.83)
Residential area[c]				
Nonmetropolitan area	1.00	1.00	1.00	1.00
Metropolitan area	0.75 (0.66, 0.86)	0.74 (0.61, 0.91)	0.73 (0.64, 0.84)	0.75 (0.62, 0.92)
Income				
1st quintile (lowest)	1.00	1.00	1.00	1.00
2nd quintile	1.48 (1.30, 1.70)	1.23 (1.03, 1.47)	1.39 (1.22, 1.60)	1.23 (1.03, 1.47)
3rd quintile	1.85 (1.62, 2.11)	1.67 (1.40, 1.99)	1.56 (1.36, 1.79)	1.68 (1.41, 2.00)
4th quintile	2.10 (1.84, 2.39)	1.72 (1.45, 2.05)	1.65 (1.44, 1.89)	1.72 (1.45, 2.04)
5th quintile (highest)	2.67 (2.35, 3.03)	1.84 (1.55, 2.19)	1.97 (1.72, 2.25)	1.82 (1.53, 2.17)
Employment status[d]				
Self-employed/small scale			1.00	1.00
Medium scale			1.55 (1.40, 1.72)	0.69 (0.46, 1.03)
Large scale			2.29 (2.05, 2.57)	1.40 (0.74, 2.63)
Not working			1.13 (0.95, 1.34)	0.92 (0.82, 1.05)
Others			1.32 (1.16, 1.51)	1.02 (0.86, 1.22)

[a] Model 1: The independent variables are age, marital status, residential area, and income; model 2: the independent variables are age, marital status, residential area, income, and employment status.
[b] Others includes never married, separated, and divorced.
[c] Metropolitan area includes 23 special wards of Tokyo and 12 ordinance-designated cities.
[d] Self-employed/small scale: self-employed or employee of a company with fewer than 30 employees; medium scale: employee in a company with 30 to 999 employees; large scale: employee in a company with at least 1000 employees.

Table 6 Adjusted odds ratios (ORs)[a] and 95% confidence intervals (CIs) for participation in screening for stomach, lung and colon cancers according to income quintile in Japanese men aged 40–64 years by residential area

	Metropolitan area[b]	Nonmetropolitan[b]
	OR (95%CI)	OR (95%CI)
Stomach cancer		
1st quintile (lowest)	1.00	1.00
2nd quintile	1.25 (0.81, 1.92)	1.31 (1.15, 1.48)
3rd quintile	2.09 (1.40, 3.13)	1.39 (1.22, 1.58)
4th quintile	2.53 (1.71, 3.74)	1.78 (1.56, 2.02)
5th quintile (highest)	3.74 (2.54, 5.52)	2.33 (2.05, 2.65)
Lung cancer		
1st quintile (lowest)	1.00	1.00
2nd quintile	2.09 (1.19, 3.65)	1.28 (1.11, 1.49)
3rd quintile	2.24 (1.30, 3.87)	1.36 (1.17, 1.57)
4th quintile	2.23 (1.31, 3.80)	1.64 (1.41, 1.90)
5th quintile (highest)	3.36 (1.99, 5.67)	1.81 (1.56, 2.10)
Colon cancer		
1st quintile (lowest)	1.00	1.00
2nd quintile	1.51 (0.90, 2.51)	1.39 (1.21, 1.60)
3rd quintile	2.25 (1.39, 3.65)	1.51 (1.31, 1.74)
4th quintile	2.28 (1.42, 3.64)	1.61 (1.40, 1.86)
5th quintile (highest)	3.10 (1.94, 4.94)	1.88 (1.63, 2.17)

[a] Adjusted for age and marital and employment statuses.
[b] Metropolitan area includes 23 special wards of Tokyo and 12 ordinance-designated cities.

lower socioeconomic status.

Last, in this study, we confirmed that people employed in a large-scale company can receive greater preventive health service benefits (18). The gradient in OR according to income quintile in model 1 was steeper than that in model 2. This finding indicates that inequality in opportunities for cancer screening according to employment status contributes to the large income-related differences in cancer screening.

One of the notable findings of this study is the difference in the association between income and screening by age group. The middle-aged group showed larger income-related differences in cancer screening participation rate than the elderly group. Although community health programs provide a feasible means of reducing income-related differences in cancer screening participation rate, the majority of people participating in these programs are the elderly (*e.g.*, national data showed that 62% of participants in stomach cancer screenings are more than 60) (27). Therefore, it is likely that these community health programs do not play a sufficient role in overcoming socioeconomic inequality among middle-aged people.

A notable inconsistency between the results of this study and those of studies in other countries is related to the type of residential area. Previous studies in other countries demonstrated that living in an urban area or a less deprived area is a positive factor in cancer screening participation (9, 21). However, in this study, we suggest that living in an urban area is a negative factor for participation, and income differences in cancer screening in urban areas are larger than those in rural areas

in Japan.

This study has several possible limitations that should be acknowledged. First, because the information on cancer screening participation was based on self-reporting, there might be a bias related to self-reporting, particularly a misclassification bias (28, 29). The self-reporting of cancer screening participation is likely to result in the overestimation of the participation rate, and the difference in the rates between self-reporting and actual participation depends on individual characteristics, including socioeconomic factors (30–32).

Second, in this study, we did not consider the type of program for each cancer screening. Programs and examinations different from the common programs include the pepsinogen method for stomach cancer, endoscopy for stomach and colon cancers, and low-dose spiral computed tomography for lung cancer (33–35). A government survey demonstrated that the cancer screening participation rate for lung cancer was higher than that for stomach cancer (13). The finding in this study is opposite from that in the government survey, suggesting that some citizens misunderstand the purposes of the examinations (*e.g.*, failure to distinguish lung cancer screening from tuberculosis examination).

Third, the income information used in this study was also obtained by self-reporting. Because income is sensitive information for respondents (36, 37), the income of the study subjects might be either over-reported or under-reported. In this study, however, the household income was determined on the basis of detailed items and for each household member. Thus, the income information used in this study is some of the most valid income information in the Japanese population (38).

Fourth, it is possible that the larger income differences in cancer screening participation among the middle-aged population and urban residents were due to the larger income inequality *per se* among these populations. However, Gini coefficients of income, a measure of inequality, were similar between the middle-aged (0.35) and elderly (0.35) groups, and between the metropolitan (0.35) and the nonmetropolitan (0.34) areas in this study sample.

Finally, because the study subjects were drawn from various residential areas, a more accurate examination of individual factors must take into account differences in the characteristics of the regions in which the individuals reside. In this study, we applied multilevel analysis to elucidate the effects of individual factors on cancer screening participation, considering that the regional variation in cancer screening participation underlies the individual variation (39, 40).

Over the past several decades, the relative health level of urban residents in Japan has deteriorated (41). In previous study, the contribution of higher mortality from cancer to this relative deterioration in health was confirmed (42). In addition to increased risk related to urban living conditions such as health risk behaviors, stress, and a less natural environment (43–45), there should be a greater focus on the significant socioeconomic inequality in health services including cancer screenings in urban areas.

Although comprehensive strategies are required to tackle income inequality, a few potential solutions can be implied on the basis of the above discussions. Health education and promotion across all socioeconomic statuses and focusing on disadvantaged populations will promote health knowledge and attitudes to overcome inequalities. The dependence of cancer screening participation on worksite could be weakened by other settings including the community and insurance. Last but not least in importance, evidence-based cancer screening should be encouraged. Promoting effective and efficient screening programs will increase opportunities for the populations requiring them.

In conclusion, this analysis demonstrated that having a higher income, as well as being married, being employed in a large-scale company, and living in a nonmetropolitan area, promote cancer screening participation. There was marked income-related inequality in cancer screening participation rates in the middle-aged population and people living in metropolitan areas. To promote cancer screening, socioeconomic factors, particularly those affecting middle-aged and urban residents, should be considered.

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