Table 2. Multivariate analysis of the association between psychological distress and demographic, medical, lifestyle, and social factors among men aged 40 to 64 years[a]

Variables	No. of persons with psychological distress /No. of participants	Multivariate OR (95% CI)[b]
Age group (years)		
40–44	128/1802	1.00 (referent)
45–49	169/2299	0.99 (0.77–1.27)
50–54	173/2781	0.85 (0.67–1.09)
55–59	168/3269	0.65 (0.50–0.83)
60–64	98/2108	0.55 (0.41–0.73)
History of diseases		
Hypertension	164/2529	1.17 (0.96–1.42)
Diabetes mellitus	98/1030	1.65 (1.30–2.10)
Stroke	24/170	2.42 (1.51–3.89)
Myocardial infarction	18/173	1.62 (0.94–2.76)
Cancer	23/307	1.26 (0.80–1.99)
Smoking status		
Never	97/2099	1.00 (referent)
Former	218/3940	1.19 (0.92–1.54)
Current	405/6087	1.38 (1.09–1.75)
Alcohol drinking status		
Never	107/1622	1.00 (referent)
Former	89/775	1.52 (1.11–2.07)
Current	531/9746	0.89 (0.71–1.11)
Body-mass index		
<18.5 kg/m^2	39/266	2.20 (1.51–3.21)
18.5–24.9 kg/m^2	457/7749	1.00 (referent)
≥25.0 kg/m^2	235/4135	0.94 (0.79–1.12)
Time spent walking per day		
<30 min	330/4418	1.13 (0.94–1.37)
30 min–1 hr	177/3807	0.80 (0.64–0.98)
≥1 hr	217/3847	1.00 (referent)
Lack of social support:		
(i) to consult when you are in trouble	339/2269	2.87 (2.30–3.58)
(ii) to consult when you are in bad physical condition	258/1777	1.11 (0.87–1.41)
(iii) to help with your daily housework	274/2205	1.23 (0.98–1.53)
(iv) to take you to a hospital	185/1340	1.14 (0.86–1.50)
(v) to take care of you	176/1261	1.28 (0.97–1.69)
No participation in community activities		
(i) Activities of neighborhood association	425/5549	1.00 (0.83–1.21)
(ii) Sports or exercise	480/6078	1.35 (1.12–1.63)
(iii) Volunteering	545/7508	1.19 (0.95–1.48)
(iv) Social gatherings	476/5964	1.23 (1.02–1.50)

Abbreviations: OR, odds ratio; CI, confidence interval.
[a]The K6 was used as an indicator of psychological distress,[3,4] with a cut-off point of ≥13 out of 24 points.[15]
[b]In the multivariate models, all variables shown in Table 2 were adjusted for each other.

Table 3. Multivariate analysis of the association between psychological distress and demographic, medical, lifestyle, and social factors among women aged 40 to 64 years[a]

Variables	No. of persons with psychological distress /No. of participants	Multivariate OR (95% CI)[b]
Age group (years)		
40–44	188/1900	1.00 (referent)
45–49	211/2440	0.87 (0.70–1.08)
50–54	217/2931	0.75 (0.60–0.93)
55–59	230/3465	0.65 (0.52–0.81)
60–64	128/2353	0.51 (0.39–0.66)
History of diseases		
Hypertension	162/2225	1.10 (0.90–1.33)
Diabetes mellitus	49/567	1.19 (0.86–1.64)
Stroke	9/61	1.84 (0.87–3.91)
Myocardial infarction	8/48	3.00 (1.34–6.73)
Cancer	55/564	1.58 (1.17–2.13)
Smoking status		
Never	649/10 120	1.00 (referent)
Former	79/819	1.32 (1.02–1.71)
Current	181/1467	1.48 (1.22–1.79)
Alcohol drinking status		
Never	440/6637	1.00 (referent)
Former	104/800	1.55 (1.21–1.98)
Current	391/5197	1.04 (0.89–1.22)
Body-mass index		
<18.5 kg/m^2	79/641	1.49 (1.14–1.93)
18.5–24.9 kg/m^2	636/8876	1.00 (referent)
≥25.0 kg/m^2	248/3423	0.98 (0.84–1.16)
Time spent walking per day		
<30 min	389/5036	0.93 (0.79–1.10)
30 min–1 hr	277/4147	0.91 (0.76–1.09)
≥1 hr	275/3623	1.00 (referent)
Lack of social support:		
(i) to consult when you are in trouble	279/1349	2.20 (1.73–2.79)
(ii) to consult when you are in bad physical condition	256/1254	1.38 (1.07–1.78)
(iii) to help with your daily housework	310/2016	1.15 (0.93–1.42)
(iv) to take you to a hospital	218/1232	1.33 (1.05–1.67)
(v) to take care of you	305/2031	1.40 (1.13–1.74)
No participation in community activities		
(i) Activities of neighborhood association	618/6833	1.26 (1.07–1.48)
(ii) Sports or exercise	702/7344	1.70 (1.43–2.02)
(iii) Volunteering	763/9303	0.97 (0.79–1.19)
(iv) Social gatherings	664/7327	1.20 (1.02–1.42)

Abbreviations: OR, odds ratio; CI, confidence interval.
[a]The K6 was used as an indicator of psychological distress,[3,4] with a cut-off point of ≥13 out of 24 points.[15]
[b]In the multivariate models, all variables shown in Table 3 were adjusted for each other.

community volunteer activities (Table 2). Among women aged 40 to 64 years, there was loss of the significant associations with a history of diabetes mellitus, history of stroke, spending less than 30 min per day walking, and lack of participation in community volunteer activities (Table 3).

Among men aged 65 years or older, there was a loss of the significant associations with age, a history of diabetes mellitus, history of myocardial infarction, being a former smoker, being a current smoker, lacking social support for consultation when in bad physical condition, and lack of participation in community sports or exercise activities (Table 4). Among women aged 65 years or older, there was a loss of the significant associations with a history of diabetes mellitus, being a former smoker, being a current

Table 4. Multivariate analysis of the association between psychological distress and demographic, medical, lifestyle, and social factors among men aged 65 years or older[a]

Variables	No. of persons with psychological distress /No. of participants	Multivariate OR (95% CI)[b]
Age group (years)		
65–69	95/2323	1.00 (referent)
70–74	114/2379	1.01 (0.75–1.35)
75–79	105/1833	0.98 (0.72–1.33)
80–84	65/925	1.01 (0.71–1.43)
≥85	31/449	0.78 (0.49–1.22)
History of diseases		
Hypertension	194/3295	1.23 (0.99–1.53)
Diabetes mellitus	77/1128	1.25 (0.95–1.64)
Stroke	61/445	1.91 (1.39–2.62)
Myocardial infarction	44/544	1.33 (0.94–1.88)
Cancer	63/860	1.39 (1.03–1.87)
Smoking status		
Never	77/1862	1.00 (referent)
Former	222/3925	1.06 (0.80–1.40)
Current	90/1855	1.05 (0.76–1.47)
Alcohol drinking status		
Never	92/1646	1.00 (referent)
Former	149/1524	1.37 (1.03–1.83)
Current	154/4573	0.75 (0.57–1.00)
Body-mass index		
<18.5 kg/m^2	35/343	1.56 (1.04–2.34)
18.5–24.9 kg/m^2	209/4597	1.00 (referent)
≥25.0 kg/m^2	91/1878	1.13 (0.86–1.47)
Time spent walking per day		
<30 min	234/2687	2.14 (1.58–2.88)
30 min–1 hr	80/2767	0.95 (0.67–1.34)
≥1 hr	63/2255	1.00 (referent)
Lack of social support:		
(i) to consult when you are in trouble	112/1039	1.87 (1.35–2.58)
(ii) to consult when you are in bad physical condition	68/614	0.90 (0.59–1.36)
(iii) to help with your daily housework	100/1198	0.92 (0.66–1.28)
(iv) to take you to a hospital	70/572	1.77 (1.18–2.67)
(v) to take care of you	81/682	1.68 (1.16–2.43)
No participation in community activities		
(i) Activities of neighborhood association	299/3693	1.82 (1.32–2.51)
(ii) Sports or exercise	285/3886	1.23 (0.92–1.64)
(iii) Volunteering	326/4641	1.64 (1.11–2.41)
(iv) Social gatherings	278/3477	1.35 (1.00–1.82)

Abbreviations: OR, odds ratio; CI, confidence interval.
[a]The K6 was used as an indicator of psychological distress,[3,4] with a cut-off point of ≥13 out of 24 points.[15]
[b]In the multivariate models, all variables shown in Table 4 were adjusted for each other.

Table 5. Multivariate analysis of the association between psychological distress and demographic, medical, lifestyle, and social factors among women aged 65 years or older[a]

Variables	No. of persons with psychological distress /No. of participants	Multivariate OR (95% CI)[b]
Age group (years)		
65–69	145/2768	1.00 (referent)
70–74	182/2863	1.06 (0.84–1.34)
75–79	176/2334	1.08 (0.84–1.37)
80–84	149/1422	1.31 (1.01–1.69)
≥85	149/1072	1.49 (1.14–1.96)
History of diseases		
Hypertension	387/4609	1.14 (0.98–1.33)
Diabetes mellitus	95/1094	1.01 (0.80–1.28)
Stroke	62/336	1.86 (1.37–2.51)
Myocardial infarction	52/382	1.46 (1.06–2.00)
Cancer	84/701	1.61 (1.25–2.08)
Smoking status		
Never	620/8138	1.00 (referent)
Former	34/346	0.94 (0.64–1.39)
Current	25/290	0.92 (0.59–1.43)
Alcohol drinking status		
Never	548/7136	1.00 (referent)
Former	65/534	1.42 (1.06–1.91)
Current	80/1324	1.01 (0.78–1.31)
Body-mass index		
<18.5 kg/m^2	73/553	1.38 (1.04–1.83)
18.5–24.9 kg/m^2	387/5388	1.00 (referent)
≥25.0 kg/m^2	178/2795	0.84 (0.70–1.02)
Time spent walking per day		
<30 min	473/4335	1.73 (1.37–2.18)
30 min–1 hr	176/3469	1.05 (0.81–1.35)
≥1 hr	103/2299	1.00 (referent)
Lack of social support:		
(i) to consult when you are in trouble	143/697	1.75 (1.29–2.37)
(ii) to consult when you are in bad physical condition	116/522	1.63 (1.14–2.31)
(iii) to help with your daily housework	168/1282	1.13 (0.86–1.48)
(iv) to take you to a hospital	106/690	1.20 (0.88–1.63)
(v) to take care of you	207/1589	1.50 (1.18–1.90)
No participation in community activities		
(i) Activities of neighborhood association	610/6034	1.38 (1.09–1.75)
(ii) Sports or exercise	623/5950	2.22 (1.72–2.85)
(iii) Volunteering	673/7419	1.69 (1.18–2.43)
(iv) Social gatherings	598/5800	1.57 (1.24–1.99)

Abbreviations: OR, odds ratio; CI, confidence interval.
[a]The K6 was used as an indicator of psychological distress,[3,4] with a cut-off point of ≥13 out of 24 points.[15]
[b]In the multivariate models, all variables shown in Table 5 were adjusted for each other.

smoker, and lacking social support for help with daily housework (Table 5).

When we further added current employment status and the duration of education as covariates in the multivariate models, as shown in Table 2 and Table 3, the multivariate-adjusted OR (95% CI) for psychological distress associated with being currently employed was 1.65 (1.30 to 2.09) among men and 1.10 (0.84 to 1.28) among women, respectively, and 0.82 (0.68 to 0.98) among men and 0.93 (0.80 to 1.09) among women for longer duration of education.

In addition, we analyzed the data using different cut-off points (≥9/24, ≥11/24, and ≥15/24), but the results did not substantially change in an analysis of all participants or in stratified analyses (data not shown).

DISCUSSION

The use of general population surveys to measure the extent of mental illness presents many challenges because the diagnostic tools employed tend to be lengthy and cumbersome.[17,18] The results of the present study suggest that use of the K6 scale as a proxy indicator of mental health impairments contributes to the investigation of factors associated with mental health at the population level.

On the basis of baseline cross-sectional data from a new, large, population-based, prospective cohort study, we found that female sex, young and old age, history of hypertension, history of diabetes mellitus, history of stroke, history of myocardial infarction, history of cancer, current smoking, former alcohol drinking, low BMI, shorter daily walking time, lack of social support, and lack of participation in community activities were all associated with psychological distress, even in multivariate analysis. Nevertheless, stratified analysis by sex and age categories (40 to 64 years, 65 years or older) revealed some differences among strata. The present findings indicate that factors associated with psychological distress differ between men and women, and also between middle-aged and elderly people.

We found that, as compared to men, women were more likely to have psychological distress, even in multivariate analysis, which was consistent with 2 previous US studies that used the K6.[5,8] Several studies have also shown that women have a higher risk of anxiety and mood disorders, suggesting that many factors, such as female hormones, personality, coping skills, and sociocultural roles, play a direct role in anxiety and mood disorders, as do socioeconomic status and comorbid conditions.[19–21]

The association of advanced age with psychological distress was substantially attenuated in multivariate analysis, suggesting that the high OR in the univariate model might be due to other variables shown in Table 1. Nevertheless, there was still a U-shaped association between age category (5-year categories from 40 to 44 years to ≥85 years) and the prevalence of psychological distress, with a nadir for those aged 65 to 69 years. This pattern of association is consistent with that of a previous study.[5] In contrast, stratified analysis revealed no apparent association between age and psychological distress among men aged 65 years or older, which suggests that age alone was not associated with psychological distress among men in this age category.

The associations of psychological distress with a history of serious disease were as unsurprising. Similar associations were also reported in a survey conducted in the United States.[5] The strong association between a history of stroke and psychological distress may be due to post-stroke depression.[22] Nevertheless, stratified analyses revealed some differences among sex and age categories. A history of hypertension was not significantly associated with psychological distress in any stratum. Although not significant, point estimates for history of hypertension were all above unity, which is suggestive of relatively small differences among strata. A history of diabetes mellitus was significantly associated with psychological distress only among men aged 40 to 64 years, indicating the potential burden of this disease among middle-aged men. A history of stroke was not significantly associated with psychological distress among women aged 40 to 64 years, but the point estimate was similar to that among women aged 65 years or older, suggesting that the disease burden was similar for women in these 2 age groups. The significant association between a history of myocardial infarction and psychological distress disappeared among men aged 40 to 64 years and 65 years or older, suggesting a potential sex difference in disease burden. A history of cancer was not significantly associated with psychological distress among men aged 40 to 64 years, although the reason for this was unclear.

We also found that former smoking, current smoking, former alcohol drinking, being underweight, and shorter daily walking time were associated with a higher prevalence of psychological distress. In contrast, we observed a lower prevalence among participants with a moderate daily walking time. The results for former smoking,[8] current smoking,[5,8] and being underweight[5] were consistent with previous studies. Stratified analyses yielded reduced point estimates for current smoking among men aged 65 years or older and women aged 65 years or older, suggesting that the smoking habit itself, as well as related factors, was not strongly associated with psychological distress among persons aged 65 years or older, in contrast to those aged 40 to 64 years.

Among the variables studied, lack of social support was most strongly associated with a high prevalence of psychological distress, even in multivariate analysis. Although this is the first large population-based epidemiological study using the K6 in an Asian country, previous studies[23,24] have used other mental health scales, such as the Geriatric Depression Scale (GDS)[25] among Japanese populations. Koizumi et al reported that negative responses to the questions "Do you have someone with whom you can consult when you are in trouble?" and "Do you have someone who can take care of you when you are ill in bed?" were significantly associated with an increase in the risk of depression.[23,24] The finding is consistent with, and supports, the present results for persons aged 65 years or older. The depressive symptoms detected by the GDS and the psychological distress detected by the K6 reflect common underlying factors.

Although lack of social support was strongly associated with a high prevalence of psychological distress, the significant association that had been found with 3 components of deficient social support disappeared on multivariate analysis among men aged 40 to 64 years (Table 2). However, lack of social support for consultation when in trouble remained strongly associated with psychological distress. These results appear to underline the importance of such support among men aged 40 to 64 years.

The association of lack of participation in community activities with psychological distress was substantially attenuated in multivariate analysis, indicating that the high OR in the univariate models could be largely explained by other variables shown in Table 1. Nevertheless, the significant increases in OR in the multivariate model indicate that lack of participation in community activities may also be associated with mental health. Stratified analysis revealed that the significant association between lack of participation in community activities in a neighborhood association disappeared among men aged 40 to 64 years, indicating the relatively low influence of neighborhood community on middle-aged men. Also, the significant association with lack of participation in volunteer activities disappeared among men and women aged 40 to 64 years, but the point estimate among men was similar to that among the total population. However, the lower point estimate on multivariate analysis suggests a relatively weak association with participation in volunteer activities among women aged 40 to 64 years.

Our data showed that being currently employed was associated with a high odds of psychological distress, and that a longer duration of education was associated with a lower odds of psychological distress, among men aged 40 to 64 years. Although the reason is unclear, our data suggest that some socioeconomic factors, such as employment and education, are important among men aged 40 to 64 years.

Our study did have some limitations. First, because of the cross-sectional design, the direction of causation for the associations observed in this report cannot be inferred from the data. Prospective studies that measure the K6 in respondents at baseline, follow the respondents over time, and measure the K6 at the end of follow-up, are needed to clarify these causal relationships.

Second, because the response rate was not high (64.5%), the respondents may not be a representative sample of the source population of Ohsaki City residents. The response rates among men and women aged 40 to 64 years were lower (54.9% and 60.4%, respectively) than those among men and women aged 65 years or older (77.1% and 73.2%, respectively). These relatively low response rates, especially among participants aged 40 to 64 years, should be kept in mind when interpreting the results from prospective, as well as cross-sectional, analyses.

Third, because the K6 does not provide information about the specific psychiatric conditions of respondents, it is difficult to identify what is being measured. However, the particular symptoms included in the K6 make it likely that severe, disabling, mood and anxiety disorders are being identified.[3,4,15,16] Although the K6 focuses on nonspecific psychological distress, the majority of cases detected by this instrument would meet the criteria for certain mental health disorders specified in the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition.[3,15]

Finally, no scales, including the present one, have been adequately validated for use as social support questionnaires in the Japanese population. Also, the first question in the questionnaire, "Do you have someone with whom you can consult when you are in trouble?", might be construed to include the participant's family, which may not qualify as social support.

In conclusion, the findings of this cross-sectional study demonstrate that the factors associated with psychological distress differ between men and women, and also between middle-aged and elderly people. These findings underline the importance of considering sex and age categories when attempting to minimize psychological distress in community-dwelling populations. To our knowledge, this is the first large population-based epidemiological study to use the K6 in an Asian country.

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No conflicts of interest are declared.

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Green tea consumption is associated with lower psychological distress in a general population: the Ohsaki Cohort 2006 Study[1–3]

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ABSTRACT

Background: Although green tea or its constituents might reduce psychological stress, the relation between green tea consumption and psychological distress has not been investigated in a large-scale study.

Objective: Our aim was to clarify whether green tea consumption is associated with lower psychological distress.

Design: We analyzed cross-sectional data for 42,093 Japanese individuals aged ≥40 y from the general population. Information on daily green tea consumption, psychological distress as assessed by the Kessler 6-item psychological distress scale, and other lifestyle factors was collected by using a questionnaire. We used multiple logistic regression analyses adjusted for age, sex, history of disease, body mass index, cigarette smoking, alcohol consumption, time spent walking, dietary factors, social support, and participation in community activities to investigate the relation between green tea consumption and psychological distress.

Results: We classified 2774 (6.6%) of the respondents as having psychological distress (Kessler 6-item psychological distress scale ≥13/24). There was an inverse association between green tea consumption and psychological distress in a model adjusted for age and sex. Although the relation was largely attenuated when possible confounding factors were adjusted for, a statistically significant inverse association remained. The odds ratio (with 95% CI) of developing psychological distress among respondents who consumed ≥5 cups of green tea/d was 0.80 (0.70, 0.91) compared with those who consumed <1 cup/d. These relations persisted when respondents were stratified by social support subgroups or by activities in communities.

Conclusion: Green tea consumption was inversely associated with psychological distress even after adjustment for possible confounding factors. *Am J Clin Nutr* 2009;90:1390–6.

INTRODUCTION

Mental health is an important component of overall well-being (1). Thus, to determine risk factors for impaired mental health or psychological distress is an important task.

Kessler et al (2) recently compared the projected lifetime risk of any mental disorder as assessed by the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (DSM-IV) in 17 countries. The risk was the lowest in metropolitan areas in China (18.0%), Nigeria (19.5%), and Japan (24.4%). These values were lower than other countries, such as the United States (55.3%), France (47.2%), and Germany (33.0%). This suggests that some cultural or lifestyle-related features of Japan, such as dietary habit, personality, or social capital, might have a positive effect on mental disorders.

Among these features, green tea consumption is a traditional part of the Japanese lifestyle (3–5), and it has long been considered that drinking green tea is associated with stress relief (6). Actually, recent trials suggest that tea consumption (6) or supplementation with L-theanine (7), which is a constituent of green tea, reduces responses to acute psychological stress when assessed as post-task cortisol (6), heart rate, and salivary immunoglobulin-A (7). Therefore, green tea consumption might be able to reduce psychological distress. However, large-scale studies have not investigated the relation between green tea and psychological distress in the general population. One reason for this might be the difficulties with assessing psychological distress in a general population. However, Kessler et al (8, 9) have developed a short form of screening scales to monitor the prevalence of psychological distress in populations [the Kessler 6-item psychological distress scale (K6)], which we applied in the present study to investigate whether green tea consumption is associated with a lower psychological distress.

SUBJECTS AND METHODS

Study design, setting, and participants

The design of the Ohsaki Cohort 2006 Study has been described in detail (10). In brief, the source population for the

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baseline survey comprised all men and women aged ≥40 y living in Ohsaki City, northeastern Japan, on 1 December 2006.

The baseline survey was conducted between 1 December and 15 December 2006. A questionnaire was distributed by the heads of individual administrative districts to individual households and collected by mail. Of the eligible 77,235 respondents, the 49,855 (26,512 men and 23,343 women; 64.5%) who provided valid responses formed the study cohort. Of the 49,855 respondents, 43,716 (87.7%) completed the K6. We excluded 1623 persons who did not complete the questionnaire regarding green tea consumption. Thus, 42,093 responses were analyzed in this study.

Measurement of psychological distress

The K6 was used as an indicator of psychological distress (8, 9). Respondents were asked about their mental status over the last month by using 6 questions to which they responded by choosing "all of the time" (4 points), "most of the time" (3 points), "some of the time" (2 points), "a little of the time" (1 point), and "none of the time" (0 points). Total point scores ranged from 0 to 24. The questions were as follows: "Over the last month, how often have you felt the following? *1*) nervous, *2*) hopeless, *3*) restless or fidgety, *4*) so sad that nothing could cheer you up, *5*) that everything was an effort, and *6*) worthless. The K6 is based on modern psychometric theory and has already outperformed some existing scales (8, 9). The Japanese version of the K6 was recently developed by using the standard back-translation method and has been validated (11). As suggested by Kessler et al (9), we classified individuals with scores of ≥13/24 as having psychological distress (10). Furukawa et al (12) investigated whether K6 was able to predict 30-d disorders of the DSM-IV as assessed by the World Health Organization Composite International Diagnostic Interview in the Australian National Survey. They showed that K6 was able to detect Composite International Diagnostic Interview/DSM-IV mood and anxiety disorders (area under the receiver operating curve: 0.89; 95% CI: 0.88, 0.90) better than the General Health Questionnaire 12 (AUC: 0.80; 95% CI: 0.78, 0.82).

Measurements of other types of exposure

The survey included questions about the frequency of recent average consumption of green tea, oolong tea, black tea, coffee, and 36 food items, as well as questions regarding alcohol and tobacco consumption, history of disease, body weight, height, and time spent walking per day. The food-frequency questionnaire did not cover a specific period of time but asked about "daily diet." The frequency of green tea consumption was categorized as never, occasionally, or 1–2, 3–4, and >5 cups/d. Within the study region, the volume of a typical cup of green tea is 100 mL.

We conducted a validation study of the food-frequency questionnaire, in which 113 respondents provided four 3-d food records within a period of 1 y and subsequently responded to the questionnaire. The Spearman rank coefficient for the correlation between amounts of consumed green tea according to the questionnaire and amounts consumed according to the food records was 0.71 for men and 0.53 for women; the correlation between consumption measured by the 2 questionnaires administered 1 y apart was 0.63 for men and 0.64 for women (13). Body mass index was calculated as the self-reported body weight (kg) divided by the square of the self-reported body height (m).

The degree of social support available to each individual was assessed by asking the following (14): Do you have someone *1*) whom you can talk to when you are in trouble? *2*) whom you can consult when you do not feel well? *3*) who can help you with your daily housework? *4*) who can take you to a hospital when you feel ill? and *5*) who can take care of you if you become bedridden? This social support questionnaire consisted of 5 questions, each requiring a "yes" or "no" answer. This questionnaire was available only in Japanese. The validity and reliability of the questionnaire were not evaluated.

We also assessed participation in community activities. We asked about how often the respondent participates in the following activities: *1*) neighborhood associations; *2*) sports, exercise, or a hobby; *3*) volunteering for nonprofit organizations; and *4*) participation in other social gatherings. The frequency of these activities was assessed as never, a few times each year, monthly, 2–3 times/month, 1 time/wk, 2–3 times/wk, and ≥4 d/wk.

Ethical issues

We considered the return of completed questionnaires to imply the consent to participate in the study involving a cross-sectional analysis of the baseline survey data and subsequent follow-up of mortality and emigration. The Ethics Committee of Tohoku University Graduate School of Medicine reviewed and approved the study protocol.

Statistical analysis

Baseline characteristics were evaluated by using the analysis of variance for continuous variables and the chi-square test for categorical variables. We also used age-sex-adjusted logistic regression analyses to clarify the age-sex-adjusted relation between green tea consumption and history of diseases. We used multivariate logistic regression analysis to calculate the odds ratios (ORs) and 95% CIs for having psychological distress (a K6 total score of ≥13/24) according to categories of green tea consumption. We established respondents who consumed <1 cup/d green tea as the reference category and examined the relation between green tea consumption and psychological distress by using the following models. Model 1 was age-sex adjusted. Model 2 was adjusted for the following physical risk factors: sex; age (40–44, 45–49, 50–54, 55–59, 60–64, 65–69, 70–74, 75–79, 80–84, and ≥85 y); history of hypertension ("yes," "no"), diabetes mellitus ("yes," "no"), stroke ("yes," "no"), myocardial infarction ("yes," "no"), and cancer ("yes," "no"); smoking status ("never," "former," "current," "missing"); alcohol consumption ("never," "former," "current," "missing"); body mass index (in kg/m^2: <18.5, 18.5–24.9, ≥25.0, missing); and time spent walking (<30 min/d, 30 min to 1 h/d, ≥1 h/d, missing). Model 3 was further adjusted for dietary factors, namely volume of rice intake and frequency of consumption of miso soup, red meat, chicken, fish, green or yellow vegetable, soy products, fruit, coffee, black tea, and oolong tea. Model 4 was fully adjusted and included the answers to the questions about social support ("yes," "no support," "missing") and participation in community activities ("yes," "never," "missing").

TABLE 1
Relation between green tea consumption and the characteristics of the participants of the Ohsaki Cohort 2006 Study[1]

	Green tea consumption (cups/d)				
	<1 (n = 10,770)	1–2 (n = 12,007)	3–4 (n = 10,364)	>5 (n = 8952)	P
Age (y)	58.5 ± 12.5[2]	59.9 ± 12.5	64.6 ± 12.0	67.5 ± 10.8	<0.01
Women [n (%)]	5090 (47)	6093 (51)	5954 (57)	5742 (64)	<0.01
Smoking [n (%)]					
Current	3249 (30)	2829 (24)	1787 (17)	1323 (15)	<0.01
Former	2319 (22)	2589 (22)	2126 (21)	1633 (18)	
Never	4749 (44)	5991 (50)	5721 (55)	5202 (58)	
Alcohol drinking [n (%)]					
Current	5797 (54)	6415 (53)	4573 (44)	3266 (36)	<0.01
Former	1020 (9)	886 (7)	802 (8)	749 (8)	
Never	3603 (33)	4244 (35)	4404 (42)	4311 (48)	
BMI [n (%)]					
18.5 kg/m^2	506 (5)	455 (4)	405 (4)	375 (4)	<0.01
18.5–24.9 kg/m^2	6517 (61)	7454 (62)	6322 (61)	5376 (60)	
≥25 kg/m^2	3077 (29)	3420 (28)	2875 (28)	2466 (28)	
Time spent walking >1 h [n (%)]	3074 (29)	3209 (27)	2717 (26)	2539 (28)	<0.01
History of diseases [n (%)]					
Hypertension	2610 (24)	3191 (27)	3296 (32)	3139 (35)	<0.01
Diabetes mellitus	850 (8)	966 (8)	981 (9)	867 (10)	<0.01
Stroke	278 (3)	269 (2)	233 (2)	183 (2)	<0.01
Myocardial infarction	243 (2)	261 (2)	307 (3)	267 (3)	<0.01
Cancer	483 (4)	571 (5)	656 (6)	643 (7)	<0.01
Volume of rice intake [n (%)]					
>3 bowls/d	1107 (10)	1135 (9)	882 (9)	687 (8)	<0.01
Consumed miso soup almost every day [n (%)]	7790 (72)	9585 (80)	8756 (84)	7715 (86)	<0.01
Frequency of food intake [n (%)]					
Red meat (at least once/wk)	8910 (83)	10225 (85)	8901 (86)	7579 (85)	<0.01
Chicken (at least once/wk)	6163 (57)	7266 (61)	6387 (62)	5432 (61)	<0.01
Fish (almost every day)	1867 (17)	2470 (21)	2814 (27)	3211 (36)	<0.01
Green yellow vegetable (almost every day)	3097 (29)	4176 (35)	4526 (44)	4795 (54)	<0.01
Soy products (almost every day)	4314 (40)	5750 (48)	5971 (58)	5859 (65)	<0.01
Fruit (almost every day)	2509 (17)	3673 (31)	4210 (41)	4626 (52)	<0.01
Frequency of beverage intake [n (%)]					
Coffee ≥1 cup/d	7749 (72)	8843 (74)	6586 (64)	4796 (54)	<0.01
Black tea ≥1 cup/d	937 (9)	2173 (18)	1875 (18)	1677 (19)	<0.01
Oolong tea ≥1 cup/d	1507 (14)	2304 (19)	1845 (18)	1714 (19)	<0.01
Social support [n (%)]					
To consult when you are in trouble (no)	1690 (16)	1567 (13)	1061 (10)	764 (9)	<0.01
To consult when you are in bad physical condition (no)	1335 (12)	1214 (10)	812 (8)	594 (7)	<0.01
To help with your daily housework (no)	1903 (18)	1834 (15)	1476 (14)	1163 (13)	<0.01
To take you to a hospital (nō)	1188 (11)	1057 (9)	782 (8)	637 (7)	<0.01
To take care of you (no)	1498 (14)	1460 (12)	1259 (12)	1096 (12)	<0.01
Participation in community activities [n (%)]					
Activities in neighborhood association (any yes)	4659 (43)	5681 (47)	5120 (49)	4352 (49)	<0.01
Sports or exercise (any yes)	4140 (38)	5283 (44)	4707 (45)	4005 (45)	<0.01
Volunteers (any yes)	2854 (27)	3588 (30)	3189 (31)	2736 (22)	<0.01
Social gathering (any yes)	4061 (38)	5271 (44)	4698 (45)	4081 (46)	<0.01

[1] For smoking, alcohol drinking, and BMI, the sum of the number of participants did not match all numbers of participants due to missing information.
[2] Mean ± SD (all such values).

We used several dummy variables to adjust for the aforementioned factors.

Because we considered that social support or community activities might modify the relation between green tea and psychological distress, we further stratified the responses by social support (support in all 5 social support categories and perception of not being supported in ≥1 of 5 social support categories) and community activity (participation in at least one community activity or none) to confirm the relation between green tea consumption and psychological distress. Those who did not answer any questions about social support or participation in community activities were excluded when stratified by social support and participation in communities, respectively. In an analysis of social support and participation in community activities, neither of these was used as the respective covariate. When we calculated the interaction of green tea with social support and participation in community activities, we used cross-product terms of green tea and social support or participation in community activities.

We also analyzed the relation between black tea consumption and psychological distress by using a fully adjusted model (model 4). All data were statistically analyzed by using SAS version 9.1 (SAS Inc, Cary, NC). All statistical tests described here were 2-sided, and $P < 0.05$ was accepted as statistically significant.

RESULTS

The association between green tea consumption and other lifestyle factors is shown in **Table 1**. The mean age, the proportion of women, the proportion of those who had never smoked or never consumed alcohol, as well as the frequency of a history of hypertension and cancer were higher among those who more frequently consumed green tea. This group also consumed more fish, soy products, green and yellow vegetables, and fruit and participated more often in community activities. Conversely, fewer respondents who consumed more green tea felt a lack of social support. Because the relation between green tea consumption and a history of diseases might be strongly confounded by age, we conducted age-sex-adjusted logistic regression analyses. The relation of green tea consumption to hypertension, diabetes, and myocardial infarction was no longer statistically significant when adjusted for age and sex (P for trends ≥ 0.13). However, the inverse association between green tea consumption and history of stroke ($P < 0.001$) and the positive relation between green tea consumption and history of cancer ($P = 0.007$) remained statistically significant.

Overall, 2774 (6.6%) respondents were considered to have psychological distress (K6 $\geq$ 13). The prevalence was the highest (8.4%) and lowest (5.1%) among those who consumed <1 and $\geq$5 cups green tea/d, respectively (*see* **Table 2**). The age-sex-adjusted model (model 1) revealed a close inverse relation between green tea consumption and having psychological distress. In comparison with individuals who consumed <1 cup/d, the ORs (95% CI) of having psychological distress for those who consumed 1–2, 3–4, and $\geq$5 cups/d were 0.79 (0.71, 0.87), 0.68 (0.61, 0.76), and 0.59 (0.52, 0.67), respectively. Although these associations were attenuated when adjusted for other lifestyle factors or a history of disease (model 2), the significant inverse association persisted (P for trend < 0.001). Although adjustment for dietary factors (model 3) and for social support or participation in community activities (model 4) also attenuated the relation, the inverse association between green tea consumption and psychological distress persisted (both P's for trend were <0.001). The adjusted ORs (95% CI) for psychological distress in subjects who consumed 1–2, 3–4, and $\geq$5 cups of green tea/d were 0.95 (0.86, 1.06), 0.89 (0.79, 1.00), and 0.80 (0.70, 0.91), respectively, in model 4, compared with the reference group.

To confirm whether the relation between green tea consumption and psychological distress persisted irrespective of social support or participation in community activities, we also investigated the association stratified in a subgroup by these 2 factors (**Table 3**). Neither an interaction between green tea consumption and social support for psychological distress ($P = 0.91$) nor an interaction between green tea consumption and participation in community activities for psychological distress ($P = 0.08$) was statistically significant.

We also analyzed the relation between the consumption of black tea and psychological distress. Compared with participants who consumed <1 cup black tea/d ($n = 35,431$), the ORs (95% CI) for those who consumed 1–2 cups black tea/d ($n = 2161$), and $\geq$3 cups black tea/d ($n = 516$) were 1.14 (0.95, 1.36) and 1.11 (0.78, 1.58), respectively.

TABLE 2
Relation between green tea consumption and psychological distress, as assessed by the Kessler 6-item psychological distress scale (K6), in the Ohsaki Cohort 2006 Study[1]

	Green tea consumption (cups/d)				
	<1 (n = 10,770)	1–2 (n = 12,007)	3–4 (n = 10,364)	>5 (n = 8952)	P for trend
No. of participants with psychological distress (K6 $\geq$13)	902	808	604	460	—
Prevalence of psychological distress (%)	8.4	6.7	5.8	5.1	—
Model 1[2]	Ref	0.79 (0.71, 0.87)[3]	0.68 (0.61, 0.76)	0.59 (0.52, 0.67)	<0.001
Model 2[4]	Ref	0.83 (0.75, 0.92)	0.73 (0.65, 0.81)	0.64 (0.57, 0.72)	<0.001
Model 3[5]	Ref	0.91 (0.82, 1.01)	0.83 (0.74, 0.93)	0.73 (0.64, 0.83)	<0.001
Model 4[6]	Ref	0.95 (0.86, 1.06)	0.89 (0.79, 1.00)	0.80 (0.70, 0.91)	<0.001

[1] Ref, referent.

[2] Adjusted for age categories (40–44, 45–49, 50–54, 55–59, 60–64, 65–69, 70–74, 75–79, 80–84, and $\geq$85 y) and for sex.

[3] Odds ratio; 95% CI in parentheses (all such values).

[4] Same as model 1 + history of hypertension (yes, no), history of diabetes mellitus (yes, no), history of stroke (yes, no), history of myocardial infarction (yes, no), history of cancer (yes, no), smoking status (never, former, current, missing), alcohol consumption (never, former, current, missing), BMI (in kg/m^2; <18.5, 18.5–24.9, $\geq$25.0, missing), and time spent walking (<30 min/d, 30 min–1 h/d, $\geq$1 h/d, missing).

[5] Same as model 2 + volume of rice intake, frequency of consumption of miso soup, red meat, chicken, fish, green and yellow vegetable, soy product, fruit, coffee, black tea, and oolong tea.

[6] Same as model 3 + social support [ie, *1*) Do you have someone with whom you can consult when you are in trouble? (yes, no, missing), *2*) Do you have someone with whom you can consult when your physical condition is not good? (yes, no, missing), *3*) Do you have someone who can help you with your daily housework? (yes, no, missing), *4*) Do you have someone who can take you to a hospital when you do not feel well? (yes, no, missing), and *5*) Do you have someone who can take care of you when you are ill in bed? (yes, no, missing)] and participation in community activities [ie, How often do you participate in the following activities? *1*) activities in neighborhood association (any yes, never, missing), *2*) sports, exercise, or hobby (any yes, never, missing), *3*) volunteer for a nonprofit organization (any yes, never, missing), and *4*) other social gatherings (any yes, never, missing)].

TABLE 3
Relation between green tea consumption and psychological distress, as assessed by the Kessler 6-item psychological distress scale (K6), stratified by social support and community activity subgroup in the Ohsaki Cohort 2006 Study[1]

	Green tea consumption (cups/d)				
	<1	1–2	3–4	>5	*P* for trend
Social support[2]					
No lack					
No. of participants	7466	8723	7799	6839	
No. of participants with psychological distress (K6 ≥ 13)	414	422	312	259	
Prevalence of psychological distress (%)	5.5	4.8	4.0	3.8	
Multiple adjusted OR (95% CI)[3]	Ref	0.99 (0.86, 1.15)	0.86 (0.73, 1.01)	0.81 (0.68, 0.96)	0.005
Any lack					
No. of participants	3283	3255	2544	2098	
No. of participants with psychological distress (K6 ≥ 13)	484	383	291	201	
Prevalence of psychological distress (%)	14.7	11.8	11.4	9.6	
Multiple adjusted OR (95% CI)[3]	Ref	0.89 (0.77, 1.04)	0.94 (0.80, 1.11)	0.77 (0.64, 0.94)	0.02
Participation in community activities[2]					
Participated					
No. of participants	6830	8281	7285	6246	
No. of participants with psychological distress (K6 ≥ 13)	370	383	288	197	
Prevalence of psychological distress (%)	5.4	4.6	4.0	3.2	
Multiple adjusted OR (95% CI)[3]	Ref	0.99 (0.85, 1.15)	0.98 (0.83, 1.16)	0.82 (0.67, 0.998)	0.08
Did not participate					
No. of participants	3759	3499	2876	2491	
No. of participants with psychological distress (K6 ≥ 13)	500	387	297	245	
Prevalence of psychological distress (%)	13.3	11.1	10.3	9.8	
Multiple adjusted OR (95% CI)[3]	Ref	0.93 (0.80, 1.08)	0.87 (0.73, 1.02)	0.82 (0.69, 0.98)	0.02

[1] OR, odds ratio; Ref, referent; "No lack," participants who perceived that they were supported for all 5 social support categories; "Any lack," participants who perceived that they were not supported for at least one social support category; "Participated," participants who participated in at least one community activity; "Did not participate," participants who did not participate in any community activities.

[2] Social support and participation in community activities were not used as covariates in analyses. *P* values for interaction for social support and participation in community activities were 0.91 and 0.08, respectively.

[3] Model 4 in Table 2 was used for adjustment.

DISCUSSION

We identified an inverse relation between green tea consumption and psychological distress as assessed by K6 in a large-sample cross-sectional study of a Japanese population. We considered that green tea consumption might contribute, at least in part, to a low lifetime risk of any mental disorder in Japan (2).

The main strength of our study is that we investigated a large sample of the general population, which allowed the consideration of many confounding factors, including social support and participation in community activities. Another strength is that we used a practical and tested questionnaire to assess psychological distress (8, 9). Of the 49,855 respondents, 88% completed the K6 [the 6-item scale developed by Kessler et al (8, 9)], which enabled an assessment of risk factors for psychological distress in a general population.

To understand whether green tea was inversely and independently related to psychological distress, we attempted several approaches to control confounding. First, we tested the effects of comorbidities or lifestyle factors on the relation. Both green tea consumption and psychological distress are inversely related with a history of cardiovascular diseases (CVDs) (10) and risk factors for CVD (10, 15, 16). Furthermore, we already reported that green tea consumption is inversely related with CVD mortality (4). Thus, CVD or risk factors for CVD can be confounding factors of the relation between green tea and psychological distress. However, the association persisted although adjustment for these factors attenuated the inverse relation between green tea consumption and psychological distress. Therefore, we considered that the relation was independent of CVD or these risk factors.

We also considered confounding by other dietary factors. Adjustments for other foods were required because the consumption of green tea might be associated with that of other Japanese foods, such as fish or soy products (5). Furthermore, the effect of other beverages on psychological distress also should be adjusted. However, adjustment for dietary factors and beverages did not fully explain the inverse relation between green tea and psychological distress. Therefore, we considered that the relation was independent of other dietary factors or beverages.

Third, we considered the effect of social support or community activities. Because green tea is the most likely beverage to be served during social activities in Japan, its consumption might be merely a marker of social support or community activity (3). In fact, our cross-sectional analyses have already shown a close inverse relation between psychological distress and social support or activities in the community (10). Thus, consideration of these factors is also important to understanding the relation between green tea consumption and psychological distress. However, we show that the inverse association between green tea consumption and psychological distress persisted even after further adjustment for social support and participation in community activities, irrespective of social support subgroup or

subgroup of community activities. Therefore, although other residual confounding factors might exist, we considered that green tea consumption was inversely and independently related to psychological distress.

Only one study has described a relation between green tea consumption and mental illness (17). Shimbo et al (17) investigated 380 Japanese individuals aged 20–69 y and assessed the relation between green tea consumption and a Japanese version of the General Health Questionnaire 12. Although they show that brewed green tea consumption was inversely associated with mental illness (OR: 0.78 for males and 0.77 for females), the relation was not statistically significant. Because the point estimate was large, Shimbo et al (17) might have detected a significant association if a sufficiently large sample had been investigated. Thus, although the assessment methods were different, we considered that our results agreed with their findings.

Some clinical trials have examined the effect of tea (6), L-theanine (7), or high doses of ascorbic acid (18) on responses to psychological stress. Both L-theanine and ascorbic acid are constituents of green tea (16). An investigation of the influence of black tea compared with a caffeine-matched placebo on both acute biological responses and the rate of poststress recovery by using double-blind methodology (6) discovered that 6 wk of tea consumption leads to lower poststress cortisol and greater subjective relaxation. Kimura et al (7) examined whether L-theanine influences the physiologic response under stress by using a mental arithmetic task as an acute stressor. They show that L-theanine intake resulted in a reduction in heart rate and salivary immunoglobulin A responses to an acute stress task relative to a placebo control. Brody et al (18) reported that high-dose ascorbic acid palliates blood pressure, cortisol, and subjective responses to acute psychological stress. These studies consistently show that the acute response to psychological stress was reduced in a group provided with tea or tea constituents. Because reducing physiologic stress might result in reduced psychological distress, these data could be considered as evidence that supports our findings.

These results from clinical trials also suggested that not only green tea but also black tea might have a beneficial effect on psychological distress because the constituents of the 2 types of tea are similar (16). In fact, Hintikka et al (19) have reported an inverse relation between the daily consumption of black tea and the risk of depression, as assessed by a postal questionnaire and the Beck Depression Inventory in a relatively large general Finnish population sample. In our study, however, we did not find any relation between consumption of black tea and psychological distress. We considered that the lack of such an association was due to the less-frequent consumption of black tea in Japan. Any relation between black tea and psychological distress might be masked by frequent consumption of green tea.

This study has some limitations. The first was the cross-sectional design. We could not conclude whether green tea reduces psychological distress or whether individuals without psychological distress are more likely to consume green tea. However, because we clarified an inverse relation between green tea consumption and psychological distress irrespective of social support and participation in community activities, we considered that green tea has a beneficial effect on psychological distress. A prospective study or a clinical trial is required to confirm this notion. Second, the correlation between the amounts of green tea consumed according to the questionnaire and the amounts consumed according to the 3-d food records was not very high (men: 0.71; women: 0.53), especially in women. Because green tea consumption varied day by day, we considered that a certain difference could be acceptable for green tea consumption. However, in any case, questionnaire surveys have some misclassifications regarding green tea consumption. Due to this limitation, we might have underestimated the inverse relation between green tea consumption and psychological distress in this study. Third, although we claimed that social support is an important confounding factor and we stratified according to this variable, the variable is not validated. However, the questionnaire comprised simple questions, and therefore we considered that it could be used for the assessment of social support. In conclusion, we showed that green tea consumption was inversely associated with psychological distress in a cross-sectional study of a large Japanese population.

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Difference in lifetime medical expenditures between male smokers and non-smokers

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ABSTRACT

Objectives: It is controversial whether smokers have higher lifetime medical expenditures than non-smokers, because smokers have high annual medical expenditures but comparatively short lives. We examined differences in lifetime medical expenditures between them.

Methods: We constructed life tables for male smokers and non-smokers from 40 years of age. We calculated average annual medical expenditures of them categorized by survivors and deceased, which were used to examine differences in lifetime medical expenditures between them and perform sensitivity analyses.

Results: Smokers had a higher mortality rate, shorter life expectancy, and generally higher annual medical expenditures than non-smokers. We also observed tendencies for smokers to have higher inpatient expenditures, but non-smokers to have higher outpatient expenditures. Although non-smokers had lower long-term cumulative medical expenditures between 64 and 81 years of age, their lifetime medical expenditures were higher by a minimal amount. Sensitivity analyses did not change this result.

Conclusions: Smoking may not cause increases in lifetime medical expenditures because smokers had lower lifetime medical expenditures than non-smokers. However, it was clear that smokers, especially survivors, often had higher annual medical expenditures than non-smokers. The importance of tobacco control is still relevant.

1. Introduction

Smoking has a major impact on both health status and medical expenditures. It is widely accepted that smoking is closely associated with morbidity and mortality from lifestyle diseases such as cancer, heart disease, cerebrovascular disease, diabetes (type 2), hypertension, and other diseases [1–4]. Therefore, many national and local governments have launched a variety of tobacco control activities [5,6], with the common understanding that smoking is one of the biggest preventable causes of disease and loss of life. On the other hand, even though tobacco-related deaths occur in Japan as well as in other countries, the Japanese tobacco control program remains significantly backward in comparison. In addition to the impact on health status, smoking has also been associated with an increase in the utilization of medical services. Previous research suggests that smokers have higher short-term medical expenditures than non-smokers [7].

Due to the increasing problem of rising medical expenditures, it has been proposed that disease prevention and health promotion may be effective approaches for

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reducing medical expenditures [8]. It is controversial whether smokers have higher lifetime medical expenditures than non-smokers, because smokers have high annual medical expenditures but comparatively short lives [9–15]. Some previous studies suggest that smokers have higher lifetime medical expenditures than non-smokers [10,13–15], while others show that smokers have lower cumulative expenditures [9,11,12]. However, most of this research estimated lifetime medical expenditures by applying economic models for mixed results from multiple databases, such as macro-data at the national level. Thus, there are limitations in the accuracy of the calculations because it is impossible to evaluate the annual medical expenditures of survivors and deceased separately while also accounting for differences in smoking status. Therefore, this study aims both to examine directly the life expectancy and the annual medical expenditures of smokers and non-smokers, and to clarify the difference in lifetime medical expenditures between them by using a simple calculation model based on a single cohort database.

2. Materials and methods

2.1. Dataset selection

We used data derived from the Ohsaki cohort study to calculate the lifetime medical expenditures of both smokers and non-smokers. Details of the Ohsaki cohort study have been described previously [16]. In brief, this study started in 1994, and this database includes the data regarding National Health Insurance (NHI) beneficiaries who lived in the catchment area of Ohsaki Public Health Center, Miyagi Prefecture, Japan. From October to December 1994, a survey was conducted of NHI beneficiaries aged 40–79 years. This survey used a self-administered questionnaire regarding various health-related lifestyle factors. Response rate for this questionnaire was very high, and 94.6% (N = 52,029) responded. Since then, utilization of medical services (medical expenditure and utilization duration per month categorized by inpatient and outpatient) and survival status have also been included.

For this study, we selected 11 years of data (January 1995 to December 2005) for males aged 40–79 years in 1995 (N = 24,573). Thus, the complete dataset included data for individuals between 40 and 90 years of age.

2.2. Calculation methods

We first constructed life tables for 100,000 male smokers (including former smokers) and 100,000 male non-smokers from 40 years of age by using mortality rates calculated from the Ohsaki cohort database and the latest published complete life tables [17]. First, we used a logistic regression model to estimate mortality rate for males at each age grouped by smokers and non-smokers. Strictly speaking, we divided each individual's multi-year data into multiple, separate single-year categories, and performed logistic regression analysis using age and smoking status as independent variables and survivor status as the dependent variable. Therefore, the 11-year survival data of an individual were divided into 11 separate single-year categories (11 survivors' data). In the case of a person who died after 4 years, data were divided into 4 separate single-year data categories (three survivors' and one deceased's data). For example, data of a person who was 40 years old in 1994 and became 51 years of age after 11 years were divided into 11 separate single-year data categories of ages 40, 41, 42, 43, 44, 45, 46, 47, 48, 49 and 50. These were treated as 11 separate single-year data points for 11 individuals. After that, we constructed life tables for both male smokers and non-smokers from 40 years of age by using the mortality rates derived from the logistic regression analysis. We used a single mortality rate (for both smokers and non-smokers) derived from the complete life tables to adjust the data after 90 years of age because we did not have data from anyone more than 90 years old in our dataset.

Next, we calculated the average annual medical expenditures (total, inpatient, and outpatient) of both smokers and non-smokers categorized by survivors and deceased. We also calculated the annual medical expenditures from data of the Ohsaki cohort study after transforming multiple-year data into multiple single-year data. In general, we calculated the annual medical expenditures in 5-year age groups, but calculated that of those who died in their 40s as a 10-year age group because data were sparse. We used the purchasing power parity rate of US$ 1.00 = JPN¥120 (2007) [18] as the exchange rate.

Finally, we examined the difference in lifetime medical expenditures between smokers and non-smokers by using the above life tables and annual medical expenditures. For both smokers and non-smokers, we multiplied the number of survivors and deceased of each age by survivor's or deceased's annual medical expenditures, respectively. We calculated long-term cumulative medical expenditure per smoker or non-smoker after summing expenditures of all ages. Moreover, we performed sensitivity analyses by using discount rates of 0%, 1%, and 5% to verify the accuracy of the results.

These analyses were performed using SPSS 15.0J for Windows (SPSS Inc., Chicago, IL, USA) and EXCEL2003 for Windows (Microsoft, Redmond, WA, USA). All reported P-values were two-tailed, and P-values <0.05 were considered significant. This study was approved by the Institutional Review Board of the Faculty of Medicine at the Graduate School of Medicine of Kyoto University, Tohoku University School of Medicine, and Nara Women's University.

3. Results

Table 1 shows the logistic regression coefficients and odds ratios with 95% confidence intervals (CIs) for the effects of age and smoking status on mortality in males. Smoking status and age were both statistically significant, and the odds ratio of smokers to non-smokers and age was 1.52 (95% CI: 1.38–1.67) and 1.10 (95% CI: 1.09–1.10), respectively. The C-index of our model was 0.74 (95% CI: 0.74–0.75), which was relatively high. When we constructed life tables for both male smokers and non-smokers from 40 years old based on the regression coefficients and information from the published complete life table, life expectancy of smokers at 40 was 39.6 years and that of

Table 1
Logistic regression coefficients and odds ratios with 95% confidence intervals for effects of age and smoking status on mortality in males.

Independent variables	Coefficient	Odds ratio	95% Confidence interval	*P*-value
Age	0.0915	1.10	(1.09–1.10)	0.000
Smoking status				
Non-smokers		1.00		
Smokers	0.417	1.52	(1.38–1.67)	0.000
Intercept	−10.6			
Hosmer-Lemeshow test		Chi-square = 7.126		0.52
C-index		0.74	(0.74–0.75)	

non-smokers was 43.1 years, suggesting that non-smokers live approximately 3.5 years longer than smokers.

Table 2 shows average annual medical expenditures (total, inpatient, and outpatient) of both smokers and non-smokers categorized by survivors and deceased. In general, smokers had higher annual medical expenditures than non-smokers, but we observed some other trends when evaluating survivors vs. deceased and inpatient vs. outpatient expenditures. Smokers tended to have higher expenditures, except in the survivors of the younger generation, although there was not a clear-cut trend in the deceased. We also observed that smokers tended to have higher inpatient expenditures, but non-smokers tended to have higher outpatient expenditures.

Table 3 shows long-term average cumulative medical expenditures per capita of smokers and non-smokers beginning from 40 years old until a specific age. Although non-smokers had lower long-term cumulative medical expenditures between 64 and 81 years of age (24–41 years beginning from 40 years of age) (data not shown), their lifetime medical expenditures were higher. The lifetime medical expenditure per capita of smokers and non-smokers was $49,980 and $51,771, respectively, and that of non-smokers was about 3.5% higher than non-smokers. Therefore, an increase of lifetime medical expenditure of less than $1800 was equivalent to a return of 3.5 years of extended life, or approximately $500 per year.

Fig. 1 shows the effect of discount rate on the difference in long-term cumulative medical expenditures between smokers and non-smokers. As discount rate increased, the difference in long-term cumulative medical expenditures between smokers and non-smokers decreased. There was little difference between smokers and non-smokers in their long-term cumulative medical expenditures at the discount rate of 5%. Changing the discount rate did not reverse the order of the two lifetime medical expenditures.

4. Discussion

In this study, we directly examined life expectancies and annual medical expenditures of smokers and non-smokers, and clarified the difference in lifetime medical expenditures between them using a single cohort database. The results suggested that: (1) smokers had a higher mortality rate than non-smokers, resulting in shortened life expectancy; (2) in general, smokers have higher annual

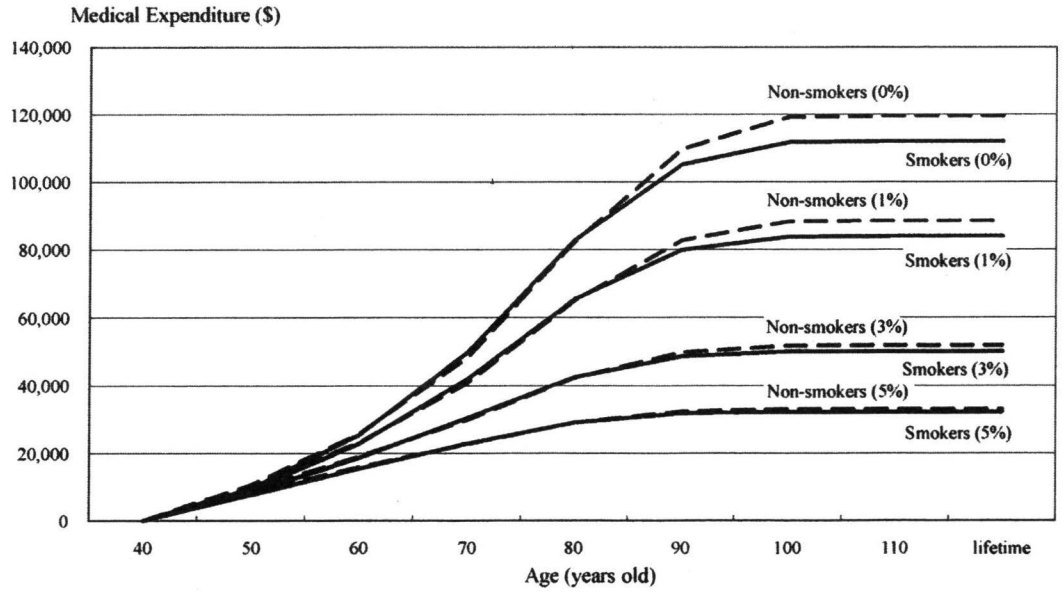

Fig. 1. Long-term average cumulative medical expenditure per capita of smokers and non-smokers by each discount rate.

Table 2
Average annual medical expenditures (total, inpatient, and outpatient) of smokers and non-smokers categorized by survivors and deceased.

Age	Total		Survivors		Deceased	
	Smokers	Non-smokers	Smokers	Non-smokers	Smokers	Non-smokers
40–44						
N	4,692	729	4,680	728	58	11
Total AME* ($)	860	869	848	869	10,238	10,558
Inpatient ($)	276	437	264	437	8,950	8,171
Outpatient ($)	584	432	584	432	1,288	2,387
45–49						
N	15,314	2,888	15,268	2,878		
Total AME	1,086	1,288	1,055	1,253		
Inpatient	396	480	367	450		
Outpatient	690	809	688	803		
50–54						
N	18,770	4,033	18,678	4,018	92	15
Total AME	1,484	1,440	1,423	1,378	14,017	18,024
Inpatient	571	546	518	498	11,205	13,421
Outpatient	914	894	904	880	2,811	4,603
55–59						
N	16,545	4,375	16,436	4,355	109	20
Total AME	1,821	1,665	1,743	1,601	13,620	15,630
Inpatient	740	539	666	486	11,974	11,983
Outpatient	1,081	1,126	1,077	1,115	1,645	3,647
60–64						
N	20,685	6,097	20,453	6,067	232	30
Total AME	2,454	2,104	2,334	2,011	13,026	20,825
Inpatient	1,089	648	977	571	10,974	16,260
Outpatient	1,365	1,455	1,358	1,440	2,052	4,565
65–69						
N	28,006	7,188	27,532	7,130	474	58
Total AME	3,138	2,753	2,940	2,665	14,599	13,601
Inpatient	1,374	959	1,183	870	12,515	11,851
Outpatient	1,763	1,794	1,758	1,795	2,085	1,750
70–74						
N	28,762	5,881	28,024	5,801	738	80
Total AME	4,331	3,886	4,049	3,722	15,037	15,752
Inpatient	1,914	1,434	1,626	1,283	12,835	12,356
Outpatient	2,417	2,452	2,423	2,439	2,202	3,396
75–79						
N	20,099	3,918	19,301	3,799	798	119
Total AME	5,043	4,703	4,632	4,450	14,987	12,778
Inpatient	2,274	1,947	1,842	1,686	12,723	10,252
Outpatient	2,769	2,757	2,790	2,764	2,264	2,526
80–84						
N	9,088	2,132	8,524	2,022	564	110
Total AME	5,355	5,078	4,907	4,577	12,131	14,281
Inpatient	2,637	2,221	2,133	1,678	10,260	12,209
Outpatient	2,718	2,857	2,774	2,899	1,871	2,071
85+						
N	2,298	667	2,098	612	200	55
Total AME	5,252	4,896	4,643	4,542	11,643	8,838
Inpatient	2,863	2,064	2,180	1,634	10,020	6,851
Outpatient	2,390	2,832	2,463	2,908	1,623	1,987
Total						
N	164,259	37,908	160,994	37,410	3,265	498
Total AME	3,068	2,781	2,847	2,633	13,947	13,957
Inpatient	1,355	1,036	1,142	899	11,868	11,314
Outpatient	1,713	1,745	1,705	1,733	2,079	2,643

*AME: average medical expenditures.

Table 3
Long-term average cumulative medical expenditures per capita of smokers and non-smokers beginning from 40 years old until specified ages (discount rate: 3% per year).

Age	Smokers	Non-smokers
40		
Survivors	100,000	100,000
Total CME* ($)	0	0
Inpatient ($)	0	0
Outpatient ($)	0	0
50 (10 years later)		
Survivors	97,732	98,499
Total CME	8,401	9,266
Inpatient	2,883	3,974
Outpatient	5,518	5,292
60 (20 years later)		
Survivors	92,304	94,856
Total CME	18,650	19,027
Inpatient	6,934	7,386
Outpatient	11,716	11,642
70 (30 years later)		
Survivors	80,085	86,361
Total CME	30,438	29,910
Inpatient	12,128	11,068
Outpatient	18,310	18,842
80 (40 years later)		
Survivors	56,402	68,444
Total CME	42,386	42,203
Inpatient	17,477	15,897
Outpatient	24,909	26,306
90 (50 years later)		
Survivors	24,056	38,701
Total CME	48,542	49,710
Inpatient	20,648	19,051
Outpatient	27,894	30,659
100 (60 years later)		
Survivors	1,482	2,384
Total CME	49,934	51,708
Inpatient	21,516	20,047
Outpatient	28,418	31,661
110 (70 years later)		
Survivors	3	5
Total CME	49,980	51,771
Inpatient	21,549	20,084
Outpatient	28,432	31,687
Lifetime		
Survivors	0	0
Total CME	49,980	51,771
Inpatient	21,549	20,084
Outpatient	28,432	31,687

*CME: cumulative medical expenditures.

medical expenditures than non-smokers; and (3) smokers had slightly lower lifetime medical expenditures than non-smokers.

Our finding that smokers had slightly lower lifetime medical expenditures than non-smokers was consistent with some previous research [9,11,12]. It would be easy to assume that this resulted from the fact that smokers have high annual medical expenditures, but comparatively short lives. However, the difference in lifetime medical expenditures between male smokers and non-smokers was relatively small. In addition, long-term cumulative medical expenditures of non-smokers were slightly lower than those of smokers between 64 and 81 years of age (24–41 years beginning from 40 years of age).

Life expectancy of smokers at 40 was 39.6 years and that of non-smokers was 43.1 years, which suggests that non-smokers live 3.5 years longer than smokers. These figures are consistent with the result of a previous study [19] which used data from another Japanese cohort and different calculation methodology. These combined data show that there is a 3.5-year disparity in life expectancy between smokers or non-smokers at the age of 40. Although this difference was smaller than other study performed in the U.K. [1], we believe the following possible reasons may have influenced our comparatively conservative estimation: (1) there may be a possible higher effect of passive smoking for non-smokers because the separation of smoking and non-smoking areas is insufficient in Japan; (2) we could not include the possible effects of changes in smoking status as we had obtained the data only once in 1994; (3) some people might have incorrectly filled in the smoking status in their questionnaires.

Although smokers had higher annual medical expenditures than non-smokers in the same age categories, we observed some countertrends when evaluating survivors vs. deceased and inpatient vs. outpatient expenditures. This suggested that it is important to understand medical expenditures after separating survivors and deceased, although this analysis has not traditionally been carried out.

The strength of this study is that the analysis is based on data from a single cohort followed up for a long time. Thus, we can access an individual's data and analyze the annual medical expenditures and survival status at each age. As such, we improved the accuracy of the lifetime medical expenditure calculation compared to previous studies that applied economic models for combining databases, such as macro-data at the national level [9–15].

Some limitations must be considered when interpreting the results of our study. First, we did not consider the possible effect of passive smoking by non-smokers. The results of the baseline survey of the Ohsaki cohort study suggested that most non-smokers were either current or former passive smokers at work or home. Strictly speaking, most non-smokers may not be pure non-smokers because most non-smokers received some effects of smoking. However, because the number of non-smokers without passive smoking was small, it would be difficult to perform this analysis if non-smokers were divided into two groups based on the status of passive smoking. In the real world, the need for this kind of consideration is questionable. A second limitation is that we did not consider the possible effects of a change in smoking status because we obtained the information only once in 1994. However, it is likely that our study avoided problems associated with a change in smoking status because we included both former and current smokers in the same group (smokers), and the results of the Ohsaki cohort study baseline survey showed that smokers were unlikely to start smoking after 40 years of age.

In conclusion, smoking may not have caused the increase of lifetime medical expenditures because smokers had slightly lower lifetime medical expenditures than

non-smokers. However, smoking does have a significant impact on health status because smoking is associated with disease, shortened life expectancy, and low quality of life. Furthermore, it was clear that smokers, especially survivors, tended to have higher annual medical expenditures than non-smokers. Since it is more meaningful to spend money to increase life expectancy and improve health, these decisions must be made by examining both health status and medical expenditures. Our results suggested that lifetime medical expenditure increased by about $500 in return for one extended year of life, but we wonder if this amount is significant. It is crucial for policy makers to consider the many harmful effects of smoking on health. The importance of tobacco control is still very relevant.

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時事評論

医師不足とジェンダー

東北大学教授　辻　一郎

現在、医師不足が深刻化している。そこで医学部の定員増が図られているが、その効果が現われるまでに10年はかかる。むしろその前に、産科医療と小児医療が崩壊してしまうのではないか？　このことが深刻に懸念されている。

遠くない将来、この二つの診療科の若手医師が激減する恐れがある。それは、若手医師の男女比を見れば分かる。平成18年の厚生労働省「医師・歯科医師・薬剤師調査」によると、20歳代後半の小児科医のうち、51％が女性であった。その年齢層の産婦人科医では73％が女性であった。その年齢層の医師全体に占める女性の割合が36％ということを考えると、この二つの診療科に女性が集中していることが分かる。

そして遠くない将来、彼らの相当数が出産・育児を経験する。それをサポートする体制が（現状のまま）不十分であれば、多くの女性医師は休業せざるを得ないであろう。ただでさえ医師不足が著しい二つの診療科で、実働部隊を担うべき30歳前後の医師たちが大量に休業すれば、現場は崩壊する。危機は、すぐ目の前に迫っているのである。

女性医師の勤務実態

日本医師会は女性医師支援センターを設置し、勤務先や再研修先の紹介などにより、女性医師の就業継続を支援している。

そのセンターが本年5月30日に「女性医師の更なる活躍のために」というテーマでシンポジウムを開催した。そこで「女性医師の勤務環境の現況に関する調査」結果が報告された。これは、全国の病院に勤務する女性医師七千余名の回答をまとめたものであるが、女性医師をめぐる厳しい現実が浮き彫りにされている。

たとえば1週間の勤務時間が60時間を超える者が全体の24％、1か月あたりの宿直が5回以上の者が15％もいた。そして回答者のほぼ3割が（昨年）有給休暇を1日も取らなかった。「職場は子育てに協力的か」との問いに、「はい」と答えた者は33％に過ぎず、「配偶者は家事・育児に協力的か」に対して「十分」または「おおむね十分」と答えた者は47％であった。

そして産前・産後休暇を「取得しなかった」者が21％もいた。その理由を尋ねると、約半数が「取り辛くて一時休職または退職した」と答えている。6割を超す者が育児休業を取っておらず、最も多い理由が「現実的にはとてもとれる状況でなかった」というものであった。

この厳しい現実に、まず目を向けていただきたい。その結果、医師のキャリアを諦める女性が少なくない現実を知っていただきたい。この厳しい現実が変わらない限り、医学部の学生定員をどんなに増やしても、医師不足は解消しないであろう。

医療福祉の最大の無駄遣い

この問題は医師に限ったものではない。看護師や介護職員など、医療福祉の職種に共通した問題なのである。

たとえば厚生労働省「第6次看護職員需給見通しに関する検討会（平成16年7月29日）」の資料によると、看護師免許を持つ65歳以下の者177万人のうち、実際に就業している者は122万人であった。その差55万人が潜在看護職員（免許を持ちながら就業していない者）となる。つまり看護師の免許を持つ者のうち、3人に1人は働いていない。その一方で、看護師不足は深刻化している。

介護労働安定センターが実施した平成20年度「介護労働実態調査」によると、訪問介護員と施設介護職員の離職率は18・7％にのぼっていた。前年度の21・6％から下がってはいるものの、職員の5分の1近くが1年間で入れ替わる状況はいかがなものだろうか。また訪問介護員では、離職率の方が採用率を上回り、就業者数が減少した。現場の人手不足はさらに深刻化している。

医師不足、看護師不足、そして介護職員不足…。その原因は、養成数の不足では決してない。むしろ養成した先から辞められることが問題なのである。これら専門職を養成するには膨大なコストがかかっている。それが活かされていないこれこそが、医療福祉における最大の無駄遣いなのではないか。

働き続けられる環境が整えば、人手不足の問題にも解決の兆しが見えるであろう。なぜ辞めるのかという問題を考えずに養成人員を増やすのは、無効どころか（財政逼迫のなかでは）有害ですらある。

経費を負担するのは、社会だけでない。何よりも本人たちが相当な努力をして、高額な学費もかけて、ようやく手にした免許・資格である。それを手放す無念さは、想像するに余りある。

これらの職種に共通することは、過酷な勤務実態（心身ともに負荷の大きい業務、休日・夜間の勤務や不規則なシフト）、その割には不十分な給与・待遇という問題に加えて、当事者の多くが女性ということである。つまりジェンダーという問題が状況をさらに複雑にしている。

過酷な労働に加えて、「家事や育児は女のすること」といった社会環境・文化のなかで彼らは二重三重に苦しんでいる。それが結局は、社会のコストを押し上げている。この問題は医療福祉の職種に留まらない。

男女共同参画は何だったか

平成11年に男女共同参画社会基本法が施行されてから、10年が経った。産前産後の休暇や育児介護休業も取りやすくなり、保育環境も整備された結果、女性の社会進出は確実に進んだ。そのことは大いに評価したい。

しかし男女共同参画社会を作るには、男性も女性も、そして社会も変わらなければならない筈である。この10年を顧みるに、女性が変わったほど、男性も変わったのだろうか？

答えは、否である。そのことは、育児介護休業を取得する男性が極めて少ないという事実からも明らかである。男性は相変わらず家庭を顧みることなく働き続け、過労死などに対する労災補償状況は依然として高水準を推移している。

結局、これまでの男女共同参画とは、オトコ社会に参画しようとする女性に便宜を図るための工夫（社会環境の調整）ではなかったか。職場のあり方や家庭のあり方といった、社会そのものを変える取り組みは、十分ではなかった。

その結果、オトコ社会に参画し続けるかどうかの選択が、女性に付いてまわることになった。頑張るか諦めるかという無意味な二者択一を迫られて、女性の中途離職が続く。そして今、わが国の医療福祉が崩壊の危機に瀕している。

男女共同参画は男性をも解放する

さて本題に戻ろう。女性医師を支援するために、我々は何を行うべきなのだろうか？

先に紹介した日本医師会のシンポジウムで基調講演を行った厚生労働省の外口崇医政局長（当時）は、冒頭に2人の先生のお言葉を紹介された。

「男女を問わず、すべての医師が、自分の理想の医療を実行することが可能となるような余裕のある職場環境を整えること」という東京女子医大の大澤真木子学部長のお言葉。

「最も大事なことは、女性医師支援のために残りの医師が協力するのではない。女性であれ男性であれ、短時間勤務の正職員が気兼ねなしに入ってこられるシステムを構築すること」という大阪厚生年金病院の消野佳紀院長のお言葉。

男女共同参画社会の実現によって解放されるのは、女性だけではない。男性にとっても生きやすい社会、それが男女共同参画社会なのではないか。

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体格が平均余命に及ぼす影響ー大崎国保コホート研究ー

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【目的】　本研究の目的は、体格と平均余命との関連を明らかにすることである。
【方法】　対象者は平成6年のベースライン調査に回答した宮城県大崎保健所管内の40～79歳の52,029名（回収率：95%）のうち、1995年1月の追跡開始時までに死亡または転出した者、がん・心筋梗塞・脳卒中の既往歴がある者、Body Mass Index（BMI）を算出できない者を除外した43,972名（男性：21,038名、女性：22,934名）で、生存状況を12年間追跡した。BMIは自己回答によって得られた身長、体重から算出し、＜18.5 kg/m^2（やせ）、18.5－24.9 kg/m^2（普通体重）、25.0－29.9 kg/m^2（過体重）、≧30.0 kg/m^2（肥満）に分類した。40歳から5歳階級ごとの総人年、死亡者数より各年齢階級の死亡率を体格別に算出した。そして、体格別の生命表を作成してそれぞれの平均余命を算出した。平均余命の95%信頼区間（CI）はChiangの方法より算出した。
【結果】　40歳男性の平均余命はやせ（33.81年、95% CI：31.98年－35.63年）で最も短く、次いで肥満（37.87年、同：35.26年－40.47年）、普通体重（38.71年、同：38.29年－39.13年）、過体重（40.46年、同：39.79年－41.13年）の順であった。やせと過体重の差は6.65年であり、やせの平均余命は普通体重、過体重に比し有意に短かった。
40歳女性の平均余命はやせ（41.12年、同：38.68年－43.56年）で最も短く、次いで肥満（44.88年、同：43.07年－46.69年）、普通体重（46.27年、同：45.81年－46.73年）、過体重（46.96年、同：46.43年－47.50年）の順であった。やせと過体重の差は5.84年であり、やせの平均余命は過体重に比し有意に短かった。
【結論】　男女とも40歳の平均余命が最も短いのはやせ、最も長いのは過体重であった。