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Health Practices and Survival Among Middle-aged Residents of Japan : A Ten-year Follow-up Cohort Study of 9 Towns in Gunma

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Abstract

To examine the relationship between health practice in combination with health examination data and mortality, a population-based prospective cohort study was conducted in 9 towns and villages of Gunma Prefecture, Japan. Public health nurses interviewed inhabitants about their health practices. This cohort consisting of 7,694 subjects aged 40～60 years old at baseline in 1993 was followed. During the ten-year follow-up period, 99 males and 80 females deceased. The relative risks (RRs) of some factors were estimated by the Cox proportional hazards model.

RRs and 95% confidence interval with multivariate adjustment for all-cause mortality were observed significantly for age in years at the baseline (1.08, 1.04～1.12, $p<0.01$), GOT (1.02, 1.00～1.05, $p<0.05$), GPT (0.98, 0.96～1.00, $p<0.05$), and no proteinuria (0.36, 0.14～0.91, $p<0.05$) in male subjects. In females, RRs (95% confidence interval) of age in years at baseline, GOT, and γ-GTP on mortality showed significance, which were 1.09 (1.05, 1.14, $p<0.01$), 1.03 (1.01, 1.05, $p<0.01$), and 1.01 (1.00, 1.01, $p<0.05$), respectively. When seven health practices and age in years at baseline were used as covariates, RRs (95% confidence interval) of age and no smoking on mortality showed 1.10 (1.06, 1.14, $p<0.01$) and 0.57 (0.37, 0.89, $p<0.05$), which were significant in males. In females, significant RRs (95% confidence interval) of age, no smoking and regular exercise on mortality were observed, which were 1.11 (1.07, 1.15, $p<0.01$), 0.48 (0.24, 0.94, $p<0.05$), and 1.63 (1.01, 2.63, $p<0.05$), respectively.

These results suggested that increased risk of death was independently associated with aging, GOT, and smoking in males and females. In addition, there was a sex difference in lifestyle-related factors such as exercise, and health examination data such as proteinuria contributing to mortality in middle-aged general inhabitants in rural towns in Japan.

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Key words: health risk appraisal, cohort study, health examination, survival

Introduction

Cohort studies on the effect of lifestyle-related factors on survival have been reported initially in the United States[1–3], and these results have been quoted for health promotion plan in Japan. As there is a gap between lifestyles of Japanese and western people, the results cannot always be applied to Japanese. The prevalence rate of disease and socio-

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Table 1 Questionnaire on health habits

Name of city, town, or village_____	ID number_____
1. Do you exercise regularly (2 ≧ / week) ?	Yes, No
2. Do you drink alcohol 6 times or more per week ?	Yes, No
3. Do you smoke?	Yes, No, Quitted
4. How many hours do you sleep?	5, 6, 7, 8, 9
5. Do you eat breakfast everyday?	Yes, No
6. Do you eat snack everyday?	Yes, No

environmental factors are different between Japan and the United States.

The author has focused on health practices in Japan[4], and previously conducted a historical cohort study of inhabitants using health examination data[5], indicating that risk factors on survival were different between men and women. Because of the methodological problem, variables were limited and a prospective cohort study is recommended to clarify risk factors on survival. Recently, the effect of lifestyle and psychosocial factors on survival was reported in Japan[6]. This information should be assessed in other community population in Japan.

In this report, the author conducted a population-based prospective cohort study targeting inhabitants living in towns or villages. By ten-year follow-up, health risk appraisal on health habits and health examination outcome was made.

Subject and Method

Subjects

Among inhabitants of 26 cities, towns or villages in Gunma prefecture, Japan, who attended annual health examination in 1993, a total of 28,830 subjects answered a short-form questionnaire on 6 health habits through interview by public health nurses. Their ages ranged from 40 to 60 years old. Among 26 municipalities, 9 local governments permitted to participate in the follow-up study. Participants provided blood samples and other health examination data. Informed consent was obtained from each participant.

Baseline Survey

The survey team was made up of public health nurses in Gunma Health Foundation and research members of the Gunma Silver Science Project (GSSP). A short-form questionnaire was used that contained 6 items of health practices (**Table 1**). Body mass index (BMI) was calculated as weight in Kilogram divided by the square of height in meters using health examination data. Good health practices scored 1 according to the following criteria; not smoking including quitting, not drinking alcohol or drinking less than six days per week, exercise more than one day per week, BMI from 20 to 28, total sleeping time between six and nine hr, eating breakfast everyday, and not snacking everyday. The other factors were categorized as 0. All quantified data were summed up as the health practices index (HPI 7), ranging from 0 to 7.

Health examination data such as sex, age in years at baseline, systolic and diastolic blood pressure (SBP, DBP), height, weight, serum creatinine (CRE), glutamic oxaloacetic transaminase (GOT), glutamic pyruvic transaminase (GPT), γ-glutamyl transpeptidase (γ-GTP), total cholesterol (CHOL), high density lipoprotein cholesterol (HDLC), triglyceride (TG), and urinalysis were used for the analysis. Atherogenic index (AI) was calculated as CHOL minus HDLC divided by HDLC.

The response rate against the number of expected subjects was 84.5% (8,410/9,947). Subjects who did not answer all 6 questions or did not take their blood or urine examinations were excluded, and a total of 7,694 fixed subjects (2,555 men and 5,139 women) were defined. The final response rate against the number of expected subjects was 77.3%.

Follow-up Survey

The survival status of subjects totaling 7,694 persons from 1993 to 2002 was checked. Death certificates of inhabitants in the 9 towns or villages

Table 2 Characteristics at the time of baseline survey including the information of death

Variables	Males				Females			
	Number	Percent	Number of death	Percent	Number	Percent	Number of death	Percent
Age								
40 ～ 44	670	26.2	12	12.1	1,393	27.1	10	12.5
45 ～ 49	581	22.7	13	13.1	1,211	23.6	7	8.8
50 ～ 54	558	21.8	23	23.2	1,055	20.5	21	26.3
55 ～ 60	746	29.2	51	51.5	1,480	28.8	42	52.5
BMI								
Not desirable	445	17.4	15	15.2	1,027	20.0	22	27.5
Desirable	2,110	82.6	84	84.8	4,112	80.0	58	72.5
ALCOHOL								
Not desirable	1,551	60.7	63	63.6	391	7.6	7	8.8
Desirable	1,003	39.3	36	36.4	4,746	92.4	73	91.3
TOBACCO								
Not desirable	1,512	59.2	69	70.4	426	8.3	11	13.8
Desirable	1,041	40.8	29	29.6	4,710	91.7	69	86.3
EXERCISE								
Not desirable	2,118	82.9	84	84.8	4,111	80.0	56	70.0
Desirable	437	17.1	15	15.2	1,028	20.0	24	30.0
SLEEP								
Not desirable	135	5.3	6	6.1	396	7.7	9	11.3
Desirable	2,420	94.7	93	93.9	4,743	92.3	71	88.8
BREAKFAST								
Not desirable	239	9.4	9	9.1	310	6.0	2	2.5
Desirable	2,316	90.6	90	90.9	4,829	94.0	78	97.5
SNACK								
Not desirable	645	25.3	19	19.2	2,608	50.8	32	40.0
Desirable	1,907	74.7	80	80.8	2,521	49.2	48	60.0

were examined in three health centers of the prefecture with formal permission from the Management and Coordination Agency of Japan. Migrations were identified in the municipal Basic Resident Registers of each town or village. Subjects who moved to other area were regarded as dropout cases.

Statistical Analysis

Fisher's exact test and Mann-Whitney U test were used for statistical analysis. Differences in the ratio and the mean value according to survival as stratified by sex were examined.

The associations between risk factors and all-cause mortality based on survival status at the end of December 2002 were analyzed. Cox proportional hazard regression analysis[7] was applied to compute relative risks (RRs) with 95% confidence intervals (CIs). Explanatory variables listed in the baseline survey section were used for the analysis. Multivariate adjusted RRs were calculated by stratification in each sex. Statistical analyses were performed with the SPSS 11.5 J statistical package for Windows (SPSS Japan Inc. Tokyo, Japan).

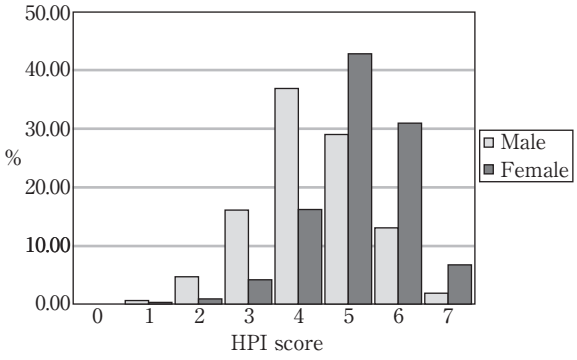

Fig. 1 The percentage of health practice index stratified by sex

Table 3 Mean and standard deviation of each indicator in men stratified by survival information

Variable	Number of case (Alive, Dead)	Alive Mean ± SD	Dead Mean ± SD
Age	(2,456, 99)	49.8 ± 6.1	53.1 ± 5.9 **
HPI7	(2,456, 99)	4.3 ± 1.1	4.3 ± 1.0
BMI	(2,456, 99)	23.1 ± 2.8	22.7 ± 2.8
SBP	(2,455, 99)	134.0 ± 16.4	138.0 ± 21.7
DBP	(2,455, 99)	80.3 ± 10.5	82.4 ± 12.2
CRE	(2,450, 99)	1.0 ± 0.14	1.0 ± 0.13
GOT	(2,450, 99)	25.6 ± 27.3	29.3 ± 24.7
GPT	(2,450, 99)	25.6 ± 33.4	25.3 ± 23.6
γ-GTP	(2,450, 99)	40.3 ± 54.0	51.2 ± 73.2
CHOL	(2,450, 99)	194.5 ± 35.0 **	181.1 ± 35.7
HDLC	(2,450, 99)	44.6 ± 12.6	45.3 ± 12.1
TG	(2,450, 99)	186.3 ± 143.0 *	159.5 ± 114.9
AI	(2,450, 99)	3.7 ± 1.6 **	3.3 ± 1.5
Proteinuria	(2,447, 98)	57 cases (2.3%)	5 cases (5.1%)
U-occult blood	(2,447, 98)	87 cases (3.6%)	4 cases (4.1%)

Mann-Whitney test was conducted. * $p < 0.05$, ** $p < 0.01$
SBP; systolic blood pressure, DBP; diastolic blood pressure, CRE; creatinine, CHOL; total cholesterol, HDLC; high density lipoprotein-cholesterol, TG; triglyceride

Result

Information on Baseline Data

The mean and standard deviation of age was 49.9±6.2 years in males, and 49.7±6.2 years in females. Other variables including socio-demographical characteristics for the target subjects are listed in **Table 2**. Percent of desirable BMI, alcohol, tobacco, exercise, sleep, breakfast and snacking in male subjects were 82.6%, 39.3%, 40.8%, 17.1%, 94.7%, 90.6%, and 74.7%, respectively, and those for female subjects were 80.0%, 92.4%, 91.7%, 20.0%, 92.3%, 94.0%, and 49.2%, respectively. Percentages of desirable alcohol, tobacco, and snacking in male and female subjects differed.

Survival Status

The average follow-up period of the target population from the date of health examination until December 31, 2002 was 3,352 days. One hundred and seventy-eight inhabitants were deceased and 201 moved out. The number of death was 99 (3.9%) in males and 80 (1.6%) in females. The distribution in the percentage of HPI 7 is shown in **Fig. 1**. There was an upward shift in the distribution of female HPI 7 compared with that of male subjects, mainly due to differences in smoking, drinking and snacking habits (**Table 2**).

1. Difference in the mean value of each factor by survival

1) Male

Table 3 shows mean and standard deviation of each factor by survival information. There was a significant difference in the mean value of age in years at baseline ($p<0.01$), CHOL ($p<0.01$), TG ($p<0.05$), and AI ($p<0.01$). Except age, the mean value of dead group was lower than that of alive group.

There was no association between the percentage of proteinuria or occult blood in urine and death.

2) Female

Table 4 shows mean and standard deviation of each factor by survival information. There was a significant difference ($p<0.01$) in the mean value of age in years at baseline, GOT, GPT, and γ-GTP, respectively. The mean values of dead group were higher than that of alive group.

There was no association between the percentage of proteinuria or occult blood in urine and death.

2. Causes of death stratified by sex

Causes of death in both male and female subjects are listed in **Table 5**. Among male subjects, the

Table 4 Mean and standard deviation of each indicator in women stratified by survival information

Variable	Number of case (Alive, Dead)	Alive Mean ± SD	Dead Mean ± SD
Age	(5,059, 80)	49.6 ± 6.2	53.5 ± 5.9 **
HPI7	(5,059, 80)	5.2 ± 1.0	5.2 ± 0.9
BMI	(5,059, 80)	23.1 ± 3.0	23.8 ± 4.7
SBP	(5,056, 80)	128.3 ± 17.0	130.7 ± 18.1
DBP	(5,056, 80)	75.1 ± 10.3	76.9 ± 10.3
CRE	(5,049, 79)	0.85 ± 0.11	0.85 ± 0.13
GOT	(5,050, 79)	19.9 ± 7.9	28.5 ± 26.2 **
GPT	(5,049, 79)	16.5 ± 11.4	24.8 ± 22.8 **
γ-GTP	(5,050, 79)	15.2 ± 16.9	24.4 ± 30.1 **
CHOL	(5,039, 79)	201.5 ± 35.5	202.6 ± 37.4
HDLC	(5,039, 79)	48.4 ± 11.5	47.1 ± 12.1
TG	(5,039, 79)	142.0 ± 91.9	146.7 ± 78.6
AI	(5,039, 79)	3.4 ± 1.3	3.6 ± 1.7
Proteinuria	(4,999, 80)	50 cases (1.0%)	2 cases (2.5%)
U-occult blood	(4,670, 80)	346 cases (7.4%)	4 cases (5.0%)

Mann-Whitney test was conducted. * $p < 0.05$, ** $p < 0.01$
Abbreviations are listed in Table 3

Table 5 Cause of death stratified by sex

Cause of death	Males	Percent	Females	Percent
Cerebrovascular Disease	13	13.1	9	11.3
Heart Disease	15	15.2	7	8.8
Malignant neoplasms	39	39.4	48	60.0
Others	32	32.3	16	20.0

number of malignant neoplasms was 39 (39.4%), heart disease 15 (15.2%), cerebrovascular disease 13 (13.1%). Among female subjects, the number of malignant neoplasms was 48 (60.0%), heart disease 7 (8.8%), cerebrovascular disease 9 (11.3%). These three causes of death comprised 67.7% in male and 80.0% in female subjects.

3. Analysis of the health hazard by Cox proportional hazard regression analysis

Because sex difference was recognized for the risk factor of death, separate analysis was made by sex. Because of the limitation of event on death, the author conducted the risk of all-cause mortality in this study. Age in years at baseline and HPI 7 scores were included to check the covariate of health examination data for the multivariate analysis. Thereafter, binary data on health practices in combination with age in years at baseline were used as covariates for the multivariate analysis to check their contribution to survival.

1) Male

Age in years at baseline, no proteinuria, and GOT were significantly contributed to the risk of death (**Table 6**). A one-year increase in age showed the RR (95%CI) to be 1.08 (1.04, 1.12). No proteinuria and GOT showed the RR (95%CI) to be 0.36 (0.14, 0.91) and 1.02 (1.00, 1.05), respectively. In contrast, GPT was inversely related to the risk of death. When GPT increased one unit, the RR (95%CI) was 0.98 (0.96, 1.00). HPI 7, which indicates good health habits when its score increases, showed no relation to the risk of death.

No smoking significantly decreased the risk of death (RR = 0.57) (**Table 7**).

2) Female

Age in years at baseline, GOT, and γ-GTP were significantly related to the risk of death (**Table 6**). A one-year increase in age showed RR (95%CI) to

Table 6 Relative risk and 95% confidence interval of each variable by Cox proportional hazard regression analysis

Variable	Males		Females	
	RR	95%CI	RR	95%CI
Age	1.08 **	1.04, 1.12	1.09 **	1.05, 1.14
HPI7	0.97	0.80, 1.17	0.97	0.77, 1.22
SBP	1.01	0.99, 1.03	0.99	0.97, 1.02
DBP	1.00	0.96, 1.04	1.02	0.98, 1.06
CRE	0.38	0.10, 1.45	0.32	0.04, 2.58
GOT	1.02 *	1.00, 1.05	1.03 **	1.01, 1.05
GPT	0.98 *	0.96, 1.00	0.99	0.97, 1.01
γ-GTP	1.00	1.00, 1.00	1.01 *	1.00, 1.01
AI	0.90	0.78, 1.04	1.07	0.91, 1.24
No U-protein	0.36 *	0.14, 0.91	0.35	0.09, 1.47
No U-occult blood	1.25	0.45, 3.47	1.86	0.67, 5.13

* $p < 0.05$, ** $p < 0.01$
RR; relative risk, CI; confidence interval, U-; Urinary
Other abbreviations are listed in Table 3

Table 7 Relative risk and 95% confidence interval of each health practice and age in years at baseline by Cox proportional hazard regression analysis

Variable	Males		Females	
	RR	95%CI	RR	95%CI
Age	1.10 **	1.06, 1.14	1.11 **	1.07, 1.15
ALCOHOL	0.97	0.64, 1.48	1.02	0.45, 2.30
TOBACCO	0.57 *	0.37, 0.89	0.48 *	0.24, 0.94
EXERCISE	0.88	0.51, 1.52	1.63 *	1.01, 2.63
BMI (Binary)	1.21	0.70, 2.11	0.65	0.40, 1.06
SLEEP	0.93	0.41, 2.13	0.67	0.33, 1.34
BREAKFAST	0.75	0.37, 1.52	2.61	0.63, 10.78
SNACK	1.26	0.76, 2.10	1.42	0.91, 2.23

* $p < 0.05$, ** $p < 0.01$
RR; relative risk, CI; confidence interval, RR of each health practice was calculated for low-compared to high risk category. Other abbreviations are listed in Table 3

be 1.09 (1.05, 1.14). When GOT or γ-GTP increased one unit, the RR (95%CI) was 1.03 (1.01, 1.05) or 1.01 (1.00, 1.01), respectively.

Exercise was found to be a risk factor on death. When subjects have an exercise habit, the RR (95%CI) was 1.63 (1.01, 2.63). Furthermore, no smoking significantly decreased the risk of death (RR = 0.48) (**Table 7**).

Considering the RR, age in years at baseline, GOT and smoking were significant contributing factors to death for both male and female subjects. Exercise in females and low GPT in males showed the adverse effect, respectively.

Discussion

Validation on This Survey

In this study, malignant neoplasms caused 39.4% and 60.0% of deceased males and females, respectively. This is almost the same with death in Japan[8], expressing that the percentage of death by malignant neoplasms were 36% (27,498/75,932) and 53% (19,308/36,118) in males and females, respectively. The questionnaire on life-style is simple, and these items have been frequently included in the survey conducted in western country.

The final response rate was 77.3%. In addition, the number of dropout was within 3%. These values seem to be acceptable for epidemiological survey[9]. Selection bias does not seem large when the health examination data is used[10].

Effects of Lifestyle Factors on Death

Breslow's seven health practices have been shown to become a risk for mortality[2]. According to the criteria with some modifications, many epidemiologic follow-up studies have been reported. In this regard, the author discussed the following lifestyle-related risk factors on mortality.

Smoking

Smoking contributes many types of cancer[11,12]. This habit is assumed to increase the frequency of cancer depending on the number of cigarettes per day. Jacobs et al.[13] reported that adjusted RR (95%CI) for all-causes death in smokers compared with non-smokers were 1.3 (1.2, 1.4) for smokers of less than 10 cigarettes per day and 1.8 (1.7, 1.9) for smokers of 10 cigarettes per day or more for middle-aged male subjects (40～59 years old). Tunstall-Pedoe et al.[14] also made a risk assessment of smoking, and RR (95%CI) were 1.53 (1.33, 1.75) in men and 1.68 (1.43, 1.99) in women by Cox proportional hazard regression analysis. Chen et al.[15] calculated RR (95%CI) of female current smokers against non-smokers to be 1.7 (1.2, 2.5). Smoking is a significant contributing factor on death. In this study, RRs of non-smoking on mortality showed 0.57 and 0.48 in males and females ($p<0.05$). At ten-year follow-up, the risk of smoking on health became clear. As the percentages of smoking in female subjects were relatively small, risk assessment of smoking on mortality should be conducted by gathering enough sample size of female subjects.

Alcohol Consumption

As the dose-response relationship between alcohol consumption and survival does not become linear but J or U shaped relationship[16], RR against no drinking might not become significant. Tunstall-Pedoe et al.[14] described RR (95%CI) of drinking to be 1.02 (0.95, 1.1) in men and 0.97 (0.8, 1.07) in women, expressing no significance. In this study, drinking alcohol did not contribute significantly on survival. As the alcohol and smoking was monitored by their frequency, the evaluation of their amount should be added to make a risk assessment in the next survey.

Obesity

The relationship between obesity and mortality remains controversial. Health hazard of severe obesity is well known in Western countries, and many prospective studies have been reported, by expressing the relationship between BMI and mortality to be linear, J- or U-shaped curve[17–19]. The degree of this relationship becomes small by aging[20]. But there was no significant relationship between obesity and mortality in this study.

The prevalence of BMI over 30 in the United States was reported to be 19.9% in male subjects and 24.9% in female subjects, respectively[21]. In this study, they were 1.5% and 2.2%, respectively. Concerning to the effect of moderate obesity on cardiovascular risk, the author recently reported a positive relationship between them[22].

Filipovsky et al.[23] showed that the risk ratio of person with not more than 24.4 of BMI or with no less than 96 mmHg of mean blood pressure was significantly high for total, cancer and cardiovascular death. Low BMI became risk factor for survival, which is consistent to our past historical cohort study[5]. There is a preventive effect on survival of loss in weight within short period[24]. They described RR (95%CI) to be 0.77 (0.59, 1.0), when over 9.1 kg reduction was succeeded within one year. Conduction of exercise program or achievement for loss in weight is effective for prevention.

In this study, BMI was classified as binary data. There was no association between BMI and survival. In general, low BMI and high BMI have different meaning for health. It is possible that some of the subjects with low BMI may have had sub-clinical disease related to weight loss at baseline such as neoplasms. When NMI was re-categorized into three levels (<18.5, 18.5～24.9, 25～), there was a significant increase of RR in lean women (BMI< 18.5) to predict mortality.

Exercise or Physical Activity

Tunstall-Pedoe et al.[14] reported RR (95%CI) of physical inactive in work against active subjects to be 1.26 (1.09, 1.45) in men and 1.54 (1.22, 1.94) in women. Compared with the most active subjects, the men and women with no weekly vigorous activity had RR (95%CI) of 1.61 (0.98, 2.64) and 4.68 (1.41, 15.57), respectively, for CVD mortality, and for the men there was a RR (95%CI) of 1.66 (0.92, 2.99) for CHD mortality[25]. We obtained a result showing reverse relationship between exercise and mortality, and regular exercise related to increase death in female subjects. The author speculates that some of the deceased subjects had been conducted a good health practices to promote their health.

Blood Pressure, Serum and Urinary Data

Tunstall-Pedoe et al.[14] reported blood pressure to be a significant contributing factor on survival not only cardiovascular death but also all-cause death. The present result showed that blood pressure has no significant relation for all-cause of death by multivariate analysis. Data on blood specimen such as CHOL, HDLC, or TG contributed little on survival in this report, which is in accordance with the past report[14]. These factors seem to have no relation to neoplasm-related mortality. Shulman et al.[26] reported that elevated serum creatinine concentration is an independent risk factor for mortality. In this study, the different conclusion was retrieved. Regarding to this fact, Avram et al.[27] reported that lower level of creatinine was significantly independent predictor of mortality by univariate and Cox's regression analysis, but the mean value of serum creatinine in their study was over 10 mg/d*l*. In their case, serum creatinine showed nutritional status of the hemodialysis patient, and there is a discrepancy of background between patients with renal failure and healthy general inhabitants in our study. As there is no evidence to explain the risk of lower serum creatinine on mortality, further follow up is needed.

In our study, proteinuria is an independent predictor of all-cause mortality. Culleton et al.[28] reported that baseline proteinuria of older people was associated with all-cause mortality with RR (95%CI) to be 1.3 (1.0, 1.8) in males and 1.4 (1.1, 1.7) in females. In our study, the level of risk was greater in male subjects, who were 20 years younger on average.

Limitation of the Research

There are several limitations in this study. Adjustment variable such as socio-demographic factors, use of preventive health services, life satisfaction, physical health status including the medical history of chronic disease and its treatment, social network could not be included. As the target subjects were participants of health examination, healthy-subjects effect may also be existed. Many of the male occupational workers have not been included in this study. Cause specific mortality could not be checked by the limitation of sample size. Furthermore, endpoint of moved-out subjects was assumed to be the same with the other subjects. The above-mentioned problems should be paid attention, which is difficult to solve in this study.

In general, death within several years after the baseline study should be excluded, because sub-clinical conditions had been existed at the baseline survey[29]. Namely, there is a possibility that sub-clinical disease at baseline might influence both lifestyle and mortality. As there was a limitation in the number of events, mainly because of the younger age in this study, information of death certificates was all used for the analysis. On a trial basis, analysis was conducted excluding those who died within the first year of the follow up. Then, significance of γ-GTP and exercise in women disappeared.

As the health examination in this study was not intended for the screening of neoplasms but for the prevention of cardiovascular and heart diseases, health habits seem not appropriate to predict death in this case. These may have influenced the results, especially in female subjects. Further, the number of deceases was only 179, thus outcomes in this study should be interpreted with caution[30].

In spite of these limitations, this study provides clarification of several variables including health practice and health examination data in middle-aged community residents on mortality.

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