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Attributable Risk Fraction of Prehypertension on Cardiovascular Disease Mortality in the Japanese Population: The Ohsaki Study

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BACKGROUND

Although relative risk of prehypertension (pre-HT) on cardiovascular disease (CVD) mortality is modest, prevalence of pre-HT is large, that is, population attributable fraction (PAF) of pre-HT on CVD mortality might be large. However, no studies have reported the fraction.

METHODS

We followed 12,928 Japanese National Health Insurance (NHI) beneficiaries aged 40–79 years without a history of CVD. On the basis of their blood pressure (BP), the participants were categorized as normal BP, pre-HT, and hypertension (HT) (Seventh Report of the Joint National Committee criteria). Multivariate-adjusted Cox proportional hazards model was used to estimate the hazard ratio (HR) of the BP status vs. CVD mortality.

RESULTS

During 12-years of follow-up, 321 participants died of CVD. As positive relation between BP category and CVD mortality was steeper in middle-aged (40–64 years) than that in elderly (65–79 years), we separately calculated PAF on CVD mortality among middle-aged and elderly. HR (95% confidence interval) for cardiovascular mortality for pre-HT and HT, respectively, was 1.31 (0.59–2.94) and 2.98 (1.39–6.41) in middle-aged, and 1.03 (0.62–1.70) and 1.65 (1.02–2.64) in elderly. Non-normal BP, i.e., pre-HT and HT, accounted for 47 and 26% of the CVD deaths among the middle-aged and elderly participants, respectively. Although the PAF of pre-HT was larger in the middle-aged participants (7%) than that in the elderly ones (0%), neither fraction was considered large.

CONCLUSION

The PAF on CVD mortality in pre-HT was not large compared with that in HT.

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Blood pressure (BP) is known to relate linearly to cardiovascular disease (CVD) mortality or incidence, and there is no threshold BP value for risk increase.[1] Furthermore, high BP is known as a leading cause of global burden of disease.[2] In light of this, the Seventh Report of the Joint National Committee on the Prevention, Detection, Evaluation, and Treatment of High Blood Pressure introduced a new category of BP patients, designated as prehypertension (pre-HT).[3] The Seventh Report of the Joint National Committee on the Prevention, Detection, Evaluation, and Treatment of High Blood Pressure reported that pre-HT category is neither a disease category nor candidate for drug therapy.[3] It also stated that individuals with pre-HT should be advised to reduce their risk of developing hypertension (HT) in the future through lifestyle modification.[3]

However, Rose reported that a large number of people at a small risk may give rise to more cases of disease than the small number who are at a high risk;[4] individuals with modest risk, such as pre-HT, might have greater impact on CVD mortality or incidence. Furthermore, an intervention study revealed the benefits and feasibility of drug treatment for subjects with pre-HT on HT incidence, indicating a possibility that drug treatment may reduce the risk of CVD mortality/incidence in subjects with pre-HT.[5] Thus, if population attributable fraction (PAF) of pre-HT on CVD were large, individuals with pre-HT should be treated appropriately. The PAF is an indicator of how much of the disease burden in a population could be eliminated if the effects of specific causal factors were eliminated from that population. However, to our knowledge, no studies calculated the excess deaths due to elevated BP and PAF among pre-HT. Therefore, we investigated the relation of BP categories with CVD mortality and estimate PAF.

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METHODS

Study setting and design. The setting and design of the Ohsaki Cohort Study have already been reported in detail.[6–8] In brief, this prospective cohort study started in 1994, when we delivered a self-administered questionnaire on various health-related lifestyles to all National Health Insurance (NHI) beneficiaries aged 40–79 years living in the catchment areas of Ohsaki Public Health Center, Miyagi Prefecture, Japan. NHI in Japan is used by farmers, the self-employed, pensioners, and their dependents. Ohsaki Public Health Center, which is a local government agency, provides preventive health services for the residents of 14 municipalities. The questionnaires were delivered to and collected from the subjects' residences by public health officials in each municipality. This procedure yielded a high response rate of 94.6% (N = 52,029). We excluded 776 subjects because they had withdrawn from the NHI before 1 January 1995, when we started the prospective collection of NHI claim files. Thus, 51,253 subjects formed the study cohort. Among the participants of the Ohsaki NHI Cohort Study, 16,515 (32.2%) had undergone an annual health checkup between April and December 1995, and they provided their consent for analysis of their results in this study. Among them, 280 participants were withdrawn before undergoing a health checkup. We also excluded those with no history of CVD (N = 502), as well as those in whom BP (N = 31), and other important confounding factors, such as total cholesterol (N = 154), glucose (N = 2,617) and body mass index (BMI) (N = 3) were not measured. Consequently, we analyzed 12,928 Japanese men and women in this study. The participants who had undergone an annual health checkup were slightly younger than those who had not (mean age: 60.8 years vs. 61.5 years, $P < 0.001$). The proportion of women was higher among the participants who underwent the annual checkup than those who did not (57.7% vs. 49.4%).

This study was approved by the ethics committee of the Tohoku University School of Medicine. The participants who had completed the self-administered questionnaires and had signed them were considered to have consented to participate in this study.

Exposure data. Data on the risk factors for CVD in the participants were obtained from results of the annual health checkup that had been organized by the local municipalities and conducted by physicians in 1995. This annual health checkup is provided free, or at low charge, to all people aged ≥40 years in Japan. The checkups include an interview; weight, height, and BP measurements; a physical examination; and blood chemistry tests to determine the serum total cholesterol, plasma glucose, and other parameters. The subjects were not instructed to fast prior to the blood chemistry tests.[8] A single BP measurement was obtained by trained nurses using automated devices after a rest for few minutes, which is standard procedure in annual health checkups in Japan.

We categorized our study participants into three groups according to the criteria provided in the Seventh Report of the Joint National Committee on the Prevention, Detection, Evaluation, and Treatment of High Blood Pressure criteria.[2] Participants with a systolic BP of ≥140 mm Hg and/or a diastolic BP of ≥90 mm Hg and/or those who were taking antihypertensive medication were regarded as HT; those who did not satisfy the HT criteria and those with a systolic BP of ≥120 mm Hg and/or a diastolic BP of ≥80 mm Hg were regarded as pre-HT; and those who did not satisfy either the HT or pre-HT criteria were regarded as normal BP. We defined hyperglycemia as either a self-reported history of diabetes or a casual plasma glucose level of ≥140 mg/dl.[9] The BMI of the participants was calculated as the ratio of the body weight (kg) to the height $(m)^2$. We defined underweight and overweight/obesity as a BMI of <18.5 kg/m^2 and ≥25 kg/m^2, respectively.[10]

Follow-up. We prospectively collected NHI claim files from the local NHI Association for all individuals in the cohort for the period from date when they received annual health check up between April 1995 and December 1995, to the date of withdrawal from the NHI because of death or emigration, or until 31 December 2006. When a beneficiary withdraws from the NHI, the date and reason are entered in the NHI withdrawal files. Both the NHI claim and withdrawal files were linked to our baseline survey data and the annual health checkup data by using each beneficiary's identification number as the key code. For decedents identified as described herein, we investigated the cause of death by reviewing the death certificates filed at Ohsaki Public Health Center. Cause of death was coded by trained physicians according to the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision. We identified deaths from CVD according to the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision codes I00–I99. None of the participants died of unknown causes. Because the Family Registration Law in Japan requires registration of death, death certificates confirmed all deaths that occurred in the study area, except participants who died after emigration from the area.

Statistical analysis. We described baseline characteristics according to BP categories using means for continuous variable and percentages for dichotomous variables. P for trends was calculated by Pearson's correlation for continuous variable and by logistic regression model for categorized variable. We estimated the age–sex or multivariate-adjusted hazard ratios (HRs) and the 95% confidence intervals for the relation of BP categories with CVD and all-cause mortality using Cox proportional hazard models. We treated participants with normal BP as a reference group. The multivariate-adjusted model included the following possible confounding factors: age, sex, BMI category (underweight, normal, and overweight/obesity), hyperglycemia, total cholesterol, and smoking (never, past, and current). We also tested the interaction of age group, i.e., middle-aged (years 40–64) and elderly (years ≥65), or sex with BP category for CVD mortality. The numbers of excess CVD or all-cause deaths due to non-normal BP were calculated as (number of cases exposed to the BP category) × (multiple adjusted HR − 1)/multiple adjusted HR, and the percentage of

excess CVD or all-cause deaths due to non-normal BP (PAF) was calculated as follows: $P \times$ (multiple adjusted HR − 1)/multiple adjusted HR, where P = proportion of cases exposed to the BP category.[11]

RESULTS

Baseline characteristics

The mean age of the study participants was 61.2 years (s.d. 9.4 years). The prevalence of pre-HT and HT was 41.8% and 40.1%, respectively. **Table 1** shows the baseline characteristics of the study participants according to the BP categories. Higher BP categories related to older age, lower prevalence of current smoking, higher prevalence of hyperglycemia, higher total cholesterol level, and higher BMI. The proportion of women in the high-BP categories was low.

Follow-up data

There were 130,782 person-years of follow-up (up to 11.7 years per person), corresponding to a follow-up rate of 88.3%. During the follow-up period, 1,227 participants died and 321 participants of them died due to CVD.

Overall, a positive relation was observed between the BP status and CVD mortality (**Table 2**). Since relation between BP categories and CVD mortality in middle-aged was stronger than that in elderly (**Table 2**, P for interaction = 0.07), we analyzed middle-aged and elderly separately. Whereas, since no sex interaction between sex and BP category for CVD mortality was observed in both age groups, we combined men and women together ($P \geq 0.18$).

Among the middle-aged patients, 8, 24, and 48 of them in the normal BP, pre-HT, and HT categories, respectively, died of CVD. Among the elderly patients, 20, 64 and 157 died of CVD in these respective categories. Thus, 30% (24/80) and 27% (64/241) of CVD deaths were observed from pre-HT categories.

PAF

The number of excess CVD deaths due to high BP was 5.7 and 31.9 in middle-aged participants with pre-HT and HT, respectively, and the corresponding PAF for CVD mortality was 7.1% and 39.9%, respectively (**Figure 1**). Non-normal BP explained 47.0% of CVD deaths among middle-aged. The PAF for CVD mortality in the elderly participants with pre-HT and HT was 0.1% and 25.7%, respectively (**Figure 1**). The sum of the excess CVD deaths (PAF) due to pre-HT and HT was 7.6 (2.4%) and 93.7 (29.2%),

Table 1 | Baseline characteristics of study participants according to blood pressure (BP) category: the Ohsaki study 1995

		Total				Age 40–64				Age ≥65			
		Normal BP	Pre-HT	HT	*P* for trend	Normal BP	Pre-HT	HT	*P* for trend	Normal BP	Pre-HT	HT	*P* for trend
Numbers of participants		2,350	5,398	5,180		1,723	3,648	2,637		627	1,750	2,543	
Age (years)	mean (s.d)	57.9 (9.8)	60.0 (9.5)	64.0 (8.2)	<0.01	53.6 (7.6)	55.1 (7.2)	57.9 (6.2)	<0.01	69.7 (3.4)	70.2 (3.8)	70.5 (3.9)	<0.01
Women	*N* (%)	1,528 (65.0%)	3,013 (55.8%)	2,869 (55.4%)	<0.01	1,169 (67.9%)	2,104 (57.7%)	1,497 (56.8%)	<0.01	359 (57.3%)	909 (51.9%)	1,372 (54.0%)	0.54
Current smoking	*N* (%)	543 (26.5%)	1,222 (26.4%)	1,085 (25.0%)	0.02	401 (26.2%)	824 (25.9%)	589 (26.0%)	0.49	142 (27.6%)	398 (27.4%)	496 (23.8%)	0.01
Past smoking	*N* (%)	216 (10.6%)	695 (15.0%)	729 (16.8%)	<0.01	123 (8.0%)	380 (12.0%)	279 (12.3%)	<0.01	93 (18.1%)	315 (21.7%)	450 (21.6%)	0.22
Never smoker	*N* (%)	1,287 (62.9%)	2,718 (58.6%)	2,534 (58.3%)	<0.01	1,008 (65.8%)	1,977 (62.2%)	1,394 (61.6%)	<0.01	279 (54.3%)	741 (51.0%)	1,140 (54.7%)	0.42
Hyperglycemia	*N* (%)	175 (7.5%)	503 (9.3%)	682 (13.2%)	<0.01	112 (6.5%)	285 (7.8%)	292 (11.1%)	<0.01	63 (10.1%)	218 (12.5%)	390 (15.3%)	<0.01
Total cholesterol (mg/dl)	mean (s.d)	200.6 (34.7)	204.1 (34.6)	207.3 (36.1)	<0.01	200.0 (34.5)	204.2 (34.6)	208.7 (36.8)	<0.01	202.1 (35.3)	203.8 (34.7)	205.9 (35.2)	<0.01
Body mass index (kg/m^2)	mean (s.d)	22.9 (2.8)	23.7 (2.9)	24.6 (3.2)	<0.01	23.0 (2.8)	23.9 (2.9)	24.9 (3.1)	<0.01	22.6 (3.0)	23.2 (2.9)	24.3 (3.3)	<0.01
Systolic BP (mm Hg)	mean (s.d)	108.9 (6.5)	128.0 (7.2)	145.6 (16.1)	<0.01	108.6 (6.6)	127.4 (7.3)	144.9 (15.7)	<0.01	109.4 (6.3)	129.3 (6.9)	146.4 (16.5)	<0.01
Diastolic BP (mm Hg)	mean (s.d)	67.7 (6.9)	78.4 (7.7)	85.7 (10.3)	<0.01	67.9 (6.7)	79.0 (7.4)	87.8 (9.5)	<0.01	67.0 (7.3)	77.1 (8.2)	83.5 (10.5)	<0.01
Antihypertensive medication	*N* (%)	0	0	2,548 (49.2%)	<0.01	0	0	1,154 (43.8%)	<0.01	0	0	1,394 (54.8%)	<0.01

BP, blood pressure; *N*, numbers of participants.
Clinic BP category: HT, hypertension (systolic BP ≥140 mm Hg and/or diastolic BP ≥90 mm Hg and/or taking antihypertensive medication); Pre-HT, prehypertension (BP level less than HT and systolic BP ≥120 mm Hg and/or diastolic BP ≥80 mm Hg); Normal BP, BP level less than pre-HT.

Table 2 | Relation of blood pressure category with cardiovascular disease and all-cause mortality, the Ohsaki study, 1995–2006

		Total			Age 40–64			Age ≥65		
		Normal BP	Pre-HT	HT	Normal BP	Pre-HT	HT	Normal BP	Pre-HT	HT
	Numbers of participants	2,350	5,398	5,180	1,723	3,648	2,637	627	1,750	2,543
	Person-years	23,709	55,040	52,033	17,413	37,611	26,886	6,296	17,429	25,146
CVD death	Numbers of CVD deaths	28	88	205	8	24	48	20	64	157
	CVD mortality rate (/1,000 person-years)	1.2	1.6	3.9	0.5	0.6	1.8	3.2	3.7	6.2
	Age–sex adjusted HR	1	1.07 (0.70–1.64)	1.93 (1.29–2.87)	1	1.18 (0.53–2.64)	2.71 (1.27–5.78)	1	1.02 (0.61–1.68)	1.70 (1.06–2.71)
	Multiple adjusted HR[a]	1	1.10 (0.72–1.69)	1.91 (1.28–2.85)	1	1.31 (0.59–2.94)	2.98 (1.39–6.41)	1	1.03 (0.62–1.70)	1.65 (1.02–2.64)
All-cause death	Numbers of all-cause deaths	153	417	657	48	126	164	105	291	493
	All-cause mortality rate (/1,000 person-years)	6.5	7.6	12.6	2.8	3.4	6.1	16.7	16.7	19.6
	Age–sex adjusted HR	1	0.93 (0.77–1.12)	1.16 (0.97–1.38)	1	1.02 (0.73–1.42)	1.52 (1.10–2.10)	1	0.89 (0.71–1.11)	1.04 (0.85–1.29)
	Multiple adjusted HR[a]	1	0.97 (0.80–1.17)	1.20 (0.995–1.43)	1	1.06 (0.76–1.49)	1.53 (1.10–2.13)	1	0.93 (0.75–1.17)	1.09 (0.88–1.35)

Clinic BP category: HT, hypertension (systolic BP ≥140 mm Hg and/or diastolic BP ≥90 mm Hg and/or taking antihypertensive medication); Pre-HT, prehypertension (BP level less than HT and systolic BP ≥120 mm Hg and/or diastolic BP ≥80 mm Hg); Normal BP, BP level less than pre-HT.
[a]Adjusted for age, sex, smoking (current, past, never), hyperglycemia, total cholesterol, BMI (underweight, normal, overweight).

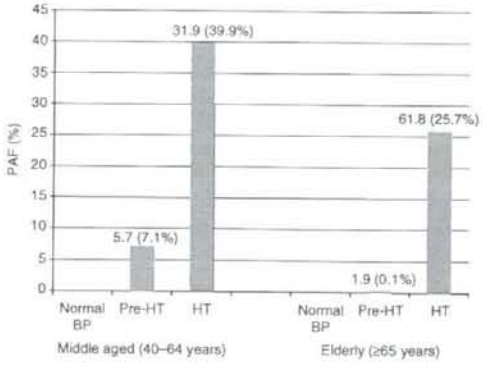

Figure 1 | Population attributable fraction (PAF) for cardiovascular diseases (CVDs) mortality in each blood pressure (BP) category. Excess CVD deaths (PAF) are shown at the top of the bars. The excess CVD mortality due to non-normal BP was calculated as (HR – 1)/HR × number of CVD deaths observed for each BP category. The PAF was calculated as the excess of CVD deaths for each BP category divided by the total number of CVD deaths. Pre-HT, prehypertension; HT, hypertension.

respectively, i.e., non-normal BP accounted for 31.6% of the CVD deaths in this Japanese population. These values remained essentially unchanged when PAF was calculated using age–sex adjusted HR instead of multiple adjusted HR (4.6% and 37.9% for middle-aged participants with pre-HT and HT and 0.5% and 26.8% for elderly participants with pre-HT and HT).

All-cause mortality

We also analyzed the relation between BP categories and all-cause mortality, and we estimated the PAF for all-cause mortality. Among middle-aged, positive relation between BP category and all-cause mortality was observed (**Table 2**). The relation was modest in elderly (**Table 2**). The excess all-cause deaths due to high BP (PAF) in middle-aged were 7.1 (2.1%) for pre-HT and 56.8 (16.8%) for HT. Similarly, the excess all-cause deaths (PAF) due to pre-HT and HT in elderly were 0 (0%) and 40.7 (4.6%), respectively. Thus, non-normal BP explained 18.9 and 4.6% of all-cause deaths among middle-aged and elderly, respectively.

DISCUSSION

In this study, based on 130,000 person-years of follow-up, we calculated the attributable risk fraction of pre-HT on CVD mortality in Japanese population. Although 25–30% CVD deaths were observed from pre-HT category, relative risk in pre-HT was modest and PAF of pre-HT on CVD mortality was not large, i.e., 7, 0, and 2% of CVD deaths were explained by pre-HT categories in middle-aged, elderly, and overall, respectively.

Our results indicate that a high BP is positively related with CVD mortality.[1,3] In addition, we found that the relation between the BP categories and CVD mortality was stronger among younger participants. These results were consistent with those from many previous studies.[1,12–14]

In our study, prevalences of pre-HT were 45.5% in middle-aged and 35.6% in elderly and 30 and 27% of CVD deaths were

observed from this category. That is, pre-HT category can be considered as one category with "large number of people at a low risk".[4] In the National Health and Nutrition Examination Survey that was conducted in 1999–2000, the prevalence of pre-HT was found to be 34.7% in the population aged 40–59 years and 23.1% in that aged 60 years and more.[15] Thus, the proportion of pre-HT is reported to be high in the United States.

In our study, the HR for CVD mortality among the middle-aged subjects with pre-HT was 1.31 (95% confidence interval: 0.59–2.94). Previous studies have reported this value to range from 1.08 to 1.80 among the pre-HT individuals.[16–20] Although the point estimate determined in this study was relatively lower than that reported previously, we considered that the HR determined here is largely consistent with that determined in previous studies. Although the risk of CVD mortality showed no increase (HR = 1.03; 95% confidence interval: 0.62–1.70) among the elderly pre-HT patients, this finding was also consistent with the results of the follow-up survey performed by National Health and Nutrition Examination Survey III.[19] Gu *et al.* reported that the risk of CVD mortality did not increase among pre-HT subjects aged 65–74 years and ≥75 years.

We investigated the PAF of high BP with regard to CVD mortality. Non-normal BP, i.e., combination of pre-HT and HT, explained 47% of CVD deaths in middle-aged and 26% of CVD deaths in elderly. This proportion was similar to the previous reports from Japan. Sairenchi *et al.* reported that PAF of non-normal BP was 60, 28, 15, and 7% of in middle-aged men, elderly men, middle-aged women, and elderly women, respectively.[14] Our findings that the PAF of non-normal BP for all-cause mortality was higher in middle-aged than that in elderly were also consistent with those of a recent report describing that the PAF of non-normal BP for all-cause mortality was higher in the 50s or 60s age group than in the 70s or 80s.[21] However, to the best of our knowledge, no study reported the fraction specific to pre-HT category. The PAF of pre-HT on CVD mortality was 7, 0, and 2% in the middle-aged, elderly, and total study population, respectively. We do not consider this proportion to be very large.

In recent years, the effects of drug treatment for prehypertensive patients to avoid progression to HT have been reported. Participants with repeated measurements of systolic pressure of 130–139 mm Hg and diastolic pressure of ≤89 mm Hg, or systolic pressure of ≤139 mm Hg, and diastolic pressure of 85–89 mm Hg were randomly assigned to receive 2 years of candesartan (N = 409) or placebo (N = 400), and followed by 2 years of placebo for all.[5] The result revealed that pre-HT patients tolerated treatment with candesartan well and that the risk of incident HT (relative risk = 0.58) reduced during the study period. Therefore, it was concluded that candesartan treatment is feasible and effective for pre-HT patients. After this trial, the topic whether pre-HT should be treated or not was debated.[22,23] However, as we have shown in this study, population impact of treatment pre-HT should not be large and HT categories explained a large proportion of excess CVD death. Furthermore, only a quarter of hypertensive is known to be well controlled, i.e., a half of hypertensives were treated and a half of treated hypertensives were well controlled at best.[3,24–27] Thus, we believe that the primary target population that should receive antihypertensive medication is that of HT patients. Further researches also should be required to estimate the burden in other population.

Our study has some limitations. First, the study population consisted of participants who underwent an annual health checkup. As this population was likely to be health conscious, the distribution of pre-HT may have been overestimated. Second, as most of Japanese annual health checkups, single measurement of BP was used for analyses. Due to regression dilution effect, relative risks might be underestimated.[28] Finally, our data were based on mortality data but not morbidity data. Although the relationship between BP categories and CVD mortality might be similar to that between BP categories and CVD morbidity, risk profiles of morbid and mortal events sometimes differ. Thus, further studies using morbidity data might be required to corroborate our findings.

In conclusion, large amount of CVD deaths were accounted for non-normal BP categories in this Japanese population. We found that the PAF of pre-HT with regard to CVD mortality was not high, while that of HT was high. Therefore, we concluded that the primary target population that should receive antihypertensive medication is that of HT patients.

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時事評論

医療保険に予防原理を

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昨年11月20日の経済財政諮問会議で麻生首相は以下のような発言を行った。

「67歳、68歳になって同窓会に行くと、よほどよぼよぼしている、医者にやたらにかかっている者がいる。彼らは、学生時代はとても元気だったが、今になるとこちらの方がはるかに医療費がかかってない。それは毎朝歩いたり何かしているからである。私の方が税金は払っている。たらたら飲んで、食べて、何もしない人の分の金を何で私が払うんだ。だから、努力して健康を保った人には何かしてくれるとか、そういうインセンティブがないといけない。予防するとごそっと減る」（同会議の議事録要旨より）。

この発言に大きな批判が集まった。思いやりに欠ける言葉に失望した国民も多かったのではないか。

しかし言い方に問題はあるが、この発言には一面の真実があることも直視すべきである。これを契機に現在の医療保険が抱える矛盾について考えてみたい。それは、平等のなかの不平等という矛盾である。

生活習慣と医療費との関係

公的保険での保険料は、所得に対する一定率または一定額として、平等に徴収される。一方、その給付（医療費）は、人により異なる。医療費の個人差は、生活習慣を始めとする疾病リスクの個人差などにより生じる。

筆者らは、宮城県大崎保健所管内の40歳以上の国保加入者約5万人を対象に、生活習慣アンケートを実施した後、各人の医療費データを10年以上にわたって調査している（大崎国保加入者コホート研究）。

それによると、喫煙者の医療費は、非喫煙者より10％も高い。そして、この集団全体が使う医療費のうち、約5％が喫煙によることが分かった。これを全国データに当てはめると、2005年の40歳以上の医療費26兆9千億円のうち1兆4千億円が喫煙によるものと換算される。この費用の一部を非喫煙者が負担している。

喫煙・肥満・運動不足という代表的な生活習慣リスクのどれも該当しない者に比べて、3つすべて該当する者の医療費は44％も高い。そして、この集団全体が使う医療費のうち、約13％がこれら3つの生活習慣リスクによる。ということは、2005年の40歳以上医療費のうち3兆6千億円が喫煙・肥満・運動不足によるものと換算される。この費用の一部を、適正体重で運動に励む非喫煙者が負担している。

喫煙・肥満・運動不足という最も基本的な生活習慣リスクだけでも、これほどのインパクトを医療費に与えている。社会保障費の圧縮目標「2200億円」とは、文字通り桁が違う。

医療保険の平等と不平等

この現実を踏まえたうえで医療保険の平等と不平等について考えてみよう。つまり、保険料は平等に徴収されているが、医療費の使い方は平等でないという矛盾である。

先述のように喫煙者の方が医療費を多く使っている。その過剰分は、喫煙者だけでなく非喫煙者も、保険料として負担している。そして医療保険財政が逼迫すると、喫煙者も非喫煙者も平等に負担増を強いられる。このようなシステムは公正と言え

本欄は、石田重森福岡大学名誉学長、堀勝洋上智大学教授、椋野美智子大分大学教授、大道久日本大学教授、増田

るのだろうか？

選択の自由が最大限に尊重される現代社会では、生活習慣や嗜好も個人の選択に任せられる。ある習慣・嗜好により本人に危害が加わることが明白でも、分かったうえでの選択ならば、よほどの危害でなければ社会は介入できない。実際、情報提供ぐらいしか手はない。

一方、本人だけでなく他者にも危害が及ぶことが証明されると、介入は正当化される。受動喫煙による健康被害を防ぐための分煙化、交通事故を防ぐための飲酒運転禁止などである。

生活習慣リスクは本人の医療費だけでなく、リスクのない者の保険料負担まで増大させるという点で、他者に影響を及ぼしている。そして今、医療保険財政は危機に瀕し、持続可能なシステムが求められている。ならば「リスクに応じた負担」を医療保険に導入しようではないか。これが実現すると、「平等のなかの不平等」という矛盾が解決するだけでなく、国民の健康レベルは上がり、保険財政も改善するだろう。

予防のインセンティブを医療保険に

具体策を提案しよう。最も簡単なのはタバコである。喫煙による超過医療費は、喫煙者にすべて負担してもらおう。先述のように、1兆4千億円の医療費が喫煙による。同年の紙巻きタバコの総販売本数2800億本で割り算すると、タバコ一本あたり4円75銭となる。この金額をタバコ価格に上乗せし、その収入を医療保険に拠出する。これで喫煙による医療費は、喫煙者がすべて支払うことになる。タバコ価格が上がれば、喫煙者も減るだろう。そうなれば喫煙による健康被害も減る。

保険証の更新の度に身長と体重を測定して、肥満度に応じた保険料を設定してはどうか。実際に肥満者の医療費は高いのだから、その程度に応じて保険料を上げればよい。そして肥満による超過医療費分を負担してもらうのである。

がん検診で発見された場合、早期がんが多いので医療費も安い。では、がん検診で発見されたら、がん医療費の自己負担率を低くしてはどうか。そうなれば受診率は上がり、がんの早期発見が増えて、がん死亡は減り、医療費も減るだろう。

欧米各国ですでに行われているように、がん検診を医療保険の予防給付で行うべきである。これにより受診率は上がるだろうし、レセプト情報を使えば精検受診率・がん発見率・偽陰性率などが容易かつ正確に把握できるので、がん検診の精度（質）は飛躍的に向上する。

ここまで言うと、（自動車保険で無事故の者の保険料が優遇されるように）一定期間受診しない被保険者に優遇措置を施すべきだと言われることがある。しかし、これは行うべきでない。受診抑制を来す可能性があるからである。早期受診が避けられたら、病状は重症化し、国民の健康が損なわれるとともに医療費も増大する恐れがある。

新しい時代の新しい医療保険

民間の自動車保険や医療保険とは異なり、公的医療保険にインセンティブを導入することに異を唱える方も多い。それは公的医療保険とは、疾病の不確実性と個人責任の免除を基本理念とし、人々の相互扶助と連帯に依拠して、受診機会の平等化を図るシステムであると広く認識されているからであろう。

しかし、この理念は感染症が主体だった時代に生まれた。疾病の原因が不明で、リスクが万人に平等であり、自助努力では身を守れなかった頃に考えられたものである。

今は、「生活習慣病」という言葉に代表されるように、生活習慣ごとの発病確率や医療費まで分かる時代である。一方、平等のなかの不平等という実態が明らかになるにつれて、相互扶助と連帯が試練に立たされている。そして受診機会の平等すら怪しくなっている。何とかしなければならない。

医療保険のあり方は、その時代の疾病構造と予防・治療の効果の程度により規定される。生活習慣病の時代における医療保険は、疾病予防と健康増進を推進するものでありたい。

［学会発表］

1．永井雅人，栗山進一，寶澤　篤，辻　一郎．
年齢階級別の BMI と全死因死亡リスクを検討した前向きコホート研究．（口演）
第 29 回日本肥満学会，大分，2008 年．

O-025

年齢階級別の BMI と全死因死亡リスクを検討した前向きコホート研究

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○永井雅人、栗山進一、寶澤　篤、辻　一郎

【目的】
Body Mass Index (BMI) と全死因死亡リスクの関係は U カーブや J カーブを描くなど、未だ一致した結論が得られていない。一方、諸外国から BMI と全死因死亡リスクの関係は、年齢階級ごとに異なる可能性が示されている。そこで、本研究では BMI と全死因死亡リスクの関係を年齢階級別に検討した。
【方法】
対象は 1994 年にベースライン調査に参加した 40 ～ 79 歳の男性 24,895 名、女性 27,134 名の計 52,029 名で、生存状況を 11 年間追跡した。
BMI を＜18.5、18.5-20.9、21.0-22.9、23.0-24.9、25.0-27.4、27.5-29.9、30.0 ≦の 7 つに分類し、男女別、年齢階級別に全死因死亡リスクとの関連を Cox 比例ハザードモデルより求めた。共変量は喫煙習慣や飲酒習慣などである。
【結果】
BMI23.0-24.9 を基準としたときの、BMI ＜ 18.5 の痩身者のハザード比 (HR) は男性の 40 ～ 54 歳、55 ～ 64 歳、65 ～ 79 歳の群でそれぞれ、0.84 (95 % 信頼区間：0.38-1.86)、1.37 (0.96-1.94)、1.49 (1.26-1.76) であった。女性の 40 ～ 54、55 ～ 64、65 ～ 79 歳の群では、1.93 (0.87-4.31)、1.29 (0.79-2.10)、1.47 (1.19-1.82) であった。一方、30 ≦ BMI の肥満者の HR は男性の 40 ～ 54 歳、55 ～ 64 歳、65 ～ 79 歳の群でそれぞれ、1.28 (0.59-2.79)、2.03 (1.27-3.24)、1.25 (0.87-1.79)、女性の 40 ～ 54、55 ～ 64、65 ～ 79 歳の群で、2.45 (1.13-5.30)、1.15 (0.67-1.99)、1.26 (0.95-1.68) であった。
【まとめ】
BMI ＜ 18.5 の痩身者のリスクは、65 歳以上の男女の高齢者で有意に上昇した。一方、30.0 ≦ BMI の肥満者のリスクは、55 ～ 64 歳の男性、40 ～ 54 歳の女性で有意に上昇した。以上より、65 歳以上の男女における全死因死亡リスクは、肥満者よりも痩身者で高かった。

2. 寶澤　篤，栗山進一，柿崎真沙子，大森　芳，大久保孝義，辻　一郎．
健診受診と死亡リスクの関連—大崎国保コホート—．（ポスター）
第67回日本公衆衛生学会総会，福岡，2008年．

07-044

健診受診と死亡リスクの関連－大崎国保コホート－

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【背景】大崎国保コホートは1994年にベースライン調査を実施した宮城県大崎保健所管内の国保加入者に対するコホート研究で、高い参加率（95%）と詳細な生活習慣の調査が特徴である。さらに基本健康診査(健診)受診者の結果も結合しており、健診データとその後の死亡リスクの関連の調査も可能である。本研究ではこの健診受診者と非受診者を比較し、1.健診受診者と非受診者の生活習慣の違い、2.健診受診者と非受診者のその後の死亡リスクの違い、3.もし死亡リスクに差があるとすれば、その差は生活習慣で説明が可能か、について検討を行う。【方法】本研究では1995年度健診の最終日まで国保に加入していた48775名（男性23451名、女性25324名）を対象とした。検討した項目は喫煙、飲酒、既往歴（脳卒中、心筋梗塞、高血圧、がん）、スポーツ、歩行時間、生きがい、主観的健康度、身体活動能力、食物摂取頻度（肉類、魚類、緑黄色野菜）、学歴、がん検診の受診歴である。また健診非受診者に対する健診受診者の死亡リスク比はコックス比例ハザードモデルを用いて推定し、多変量モデルでは上記の要因を調整した。【結果】健診の受診者は男性で6814名（29.1%）、女性で9171名（36.2%）であった。男女とも健診受診者で喫煙率、脳卒中、心筋梗塞、がんの既往歴が低かった。「生きがいがある」と答えた者、主観的健康度が「非常に健康/まあ健康」と答えた者、中～高強度の活動に問題がない者、緑黄色野菜の摂取頻度が多い者の割合、各種がん検診の受診率は健診受診者で高かった。12年間の追跡で男性4641名、女性2644名の死亡が観察された。総死亡、循環器疾患死亡、がん死亡、その他の死亡のリスク比はいずれも健診受診者で有意に低かった（年齢調整ハザード比は男性でそれぞれ0.56、0.47、0.66、0.53、女性でそれぞれ0.47、0.47、0.56、0.41）。これらの死亡リスク比は多変量調整後に若干上昇（多変量調整ハザード比は男性でそれぞれ0.70、0.60、0.74、0.66、女性でそれぞれ0.60、0.59、0.64、0.51）するものの、いずれも有意に低下していた。【考察】健診受診者は健診非受診者よりも健康的な生活習慣であった。健診受診者の死亡リスクは非受診者よりも低く、今回の調整項目ではこの死亡リスクの低下は十分に説明されなかった。特に循環器疾患以外の死亡リスクも低下していることから残余交絡の影響が考えられる。

3. 永井雅人，柿崎真沙子，栗山進一，大森　芳，菅原由美，曽根稔雅，寶澤　篤，辻　一郎．
性別にみたBMIと死因別死亡リスクに関する前向きコホート研究
−大崎国保コホート研究−．（口演）
第19回日本疫学会学術総会，金沢，2009年．

O3-07

性別にみたBMIと死因別死亡リスクに関する前向きコホート研究－大崎国保コホート研究—

永井雅人、柿崎真沙子、栗山進一、大森　芳、菅原由美、曽根稔雅、寶澤　篤、辻　一郎
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【目的】我々は本研究データにおいて、Body Mass Index (BMI)と全死因死亡リスクとの関連が男女ともUカーブを描くこと、男性では痩せと肥満のリスクは同程度であるのに対して、女性では痩せのリスクは肥満よりも高いことを以前に報告した。本研究ではこの男女差の要因を解明するため、BMI と死因別死亡リスクとの関連を性別に検討した。

【方法】対象者は、宮城県大崎保健所管内の40～79歳の国民健康保険加入者全員(54,996名)を対象とする平成6年のベースライン調査に回答した52,029名(回収率: 95%)のうち、がん・心筋梗塞・脳卒中の既往歴がある者、BMIを算出できない者を除外した43,984名(男性: 21,042名、女性: 22,942名)である。12 年間の追跡で、5,709 名の死亡が観察された(虚血性心疾患(IHD): :376 名、脳卒中: 766 名、がん: 1,966名、肺炎: 434名)。BMIを<18.5(痩せ)、18.5–24.9、25.0–29.9(過体重)、≥30.0(肥満)に分類し、死因別死亡リスクをCox比例ハザードモデルより算出した。

【結果】IHD 死亡リスクは、男女とも痩せ及び肥満で上昇した。痩せでのリスク上昇は女性で顕著であった。一方、肥満でのリスク上昇は男女とも同様であった。脳卒中死亡リスクは、男女とも肥満で上昇する傾向を示し、男性で顕著だった。がん死亡リスクは、男女とも有意な関連はみられなかったが、肥満で上昇する傾向があり、それは女性でやや強かった。肺炎死亡リスクは、男女とも痩せで有意に上昇した。一方、肥満でのリスク上昇は男性でしかみられなかった(表)。

【結論】BMIと全死因死亡リスクとの関連でみられた男女差は、痩せでのIHD死亡リスクが男性より女性、肥満での脳卒中、肺炎死亡リスクが女性より男性で顕著であったことによることが示唆された。

表　BMIと死因別死亡リスクのHRと95%CI

	Body Mass Index			
	<18.5	18.5–24.9	25.0–29.9	≥30
虚血性心疾患(IHD)				
男性 HR(95%CI)	1.56 (0.94 – 2.56)	1.00 (reference)	1.09 (0.75 – 1.59)	1.88 (0.66 – 5.36)
女性 HR(95%CI)	2.12 (1.23 – 3.63)	1.00 (reference)	1.56 (1.02 – 2.39)	1.61 (0.66 – 3.97)
脳卒中				
男性 HR(95%CI)	1.11 (0.73 – 1.68)	1.00 (reference)	1.05 (0.80 – 1.37)	1.67 (0.85 – 3.28)
女性 HR(95%CI)	1.28 (0.84 – 1.95)	1.00 (reference)	0.93 (0.69 – 1.23)	1.28 (0.75 – 2.18)
がん				
男性 HR(95%CI)	1.13 (0.89 – 1.44)	1.00 (reference)	0.97 (0.83–1.13)	1.35 (0.88 – 2.08)
女性 HR(95%CI)	1.00 (0.68 – 1.46)	1.00 (reference)	1.03 (0.84 – 1.28)	1.44 (0.97 – 2.15)
肺炎				
男性 HR(95%CI)	2.28 (1.61 – 3.23)	1.00 (reference)	0.93 (0.65 – 1.34)	1.48 (0.57 – 3.83)
女性 HR(95%CI)	2.34 (1.37 – 4.00)	1.00 (reference)	1.22 (0.76 – 1.97)	0.81 (0.28 – 2.40)

HR: ハザード比、95%CI: 95%信頼区間
補正項目: 年齢、20歳からの体重変化、学歴、配偶者の有無、喫煙習慣、飲酒習慣、歩行時間、身体活動時間、腎疾患の既往歴、肝疾患の既往歴

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