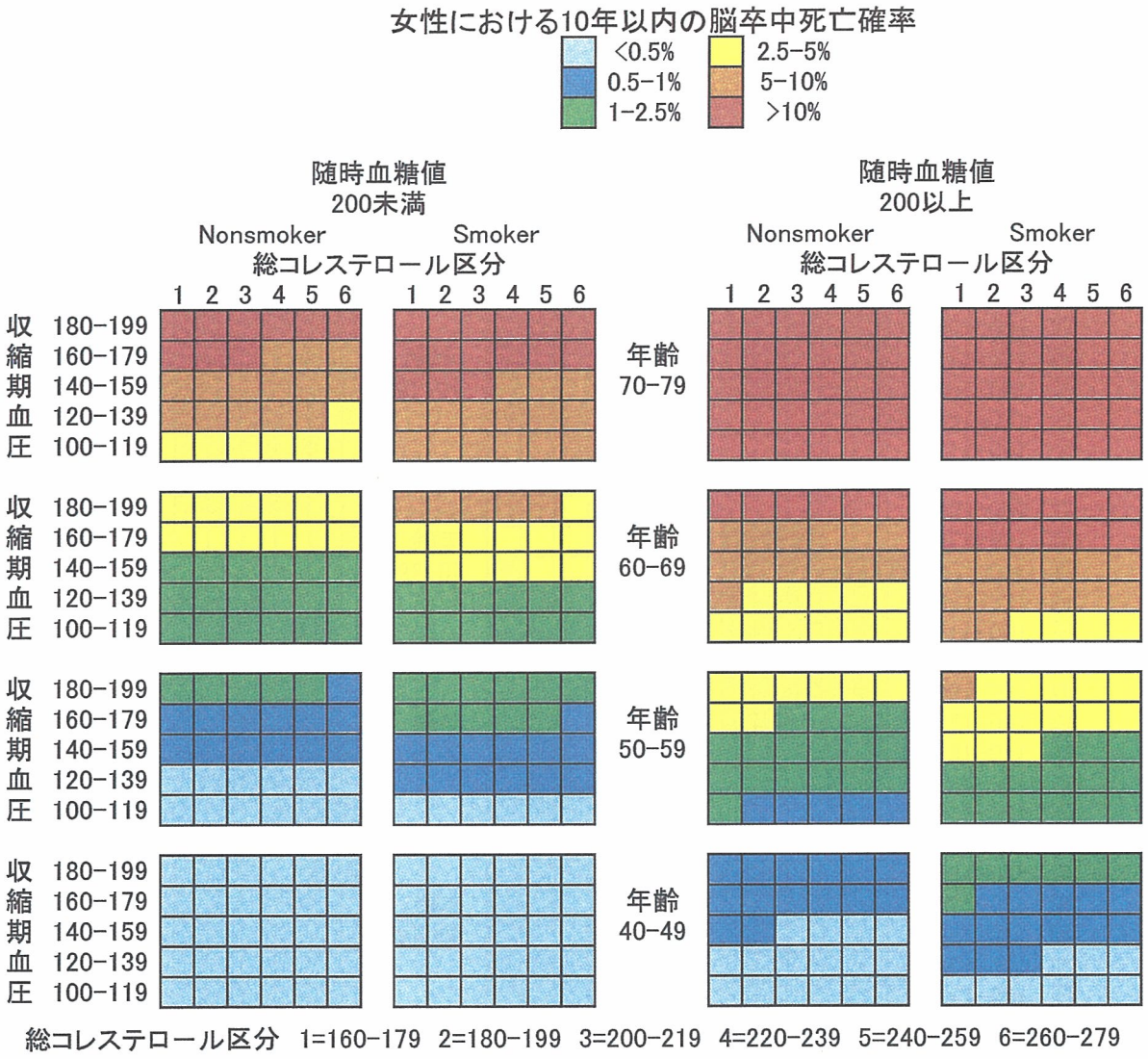

図 4. 脳卒中健康度評価チャートー女性ー

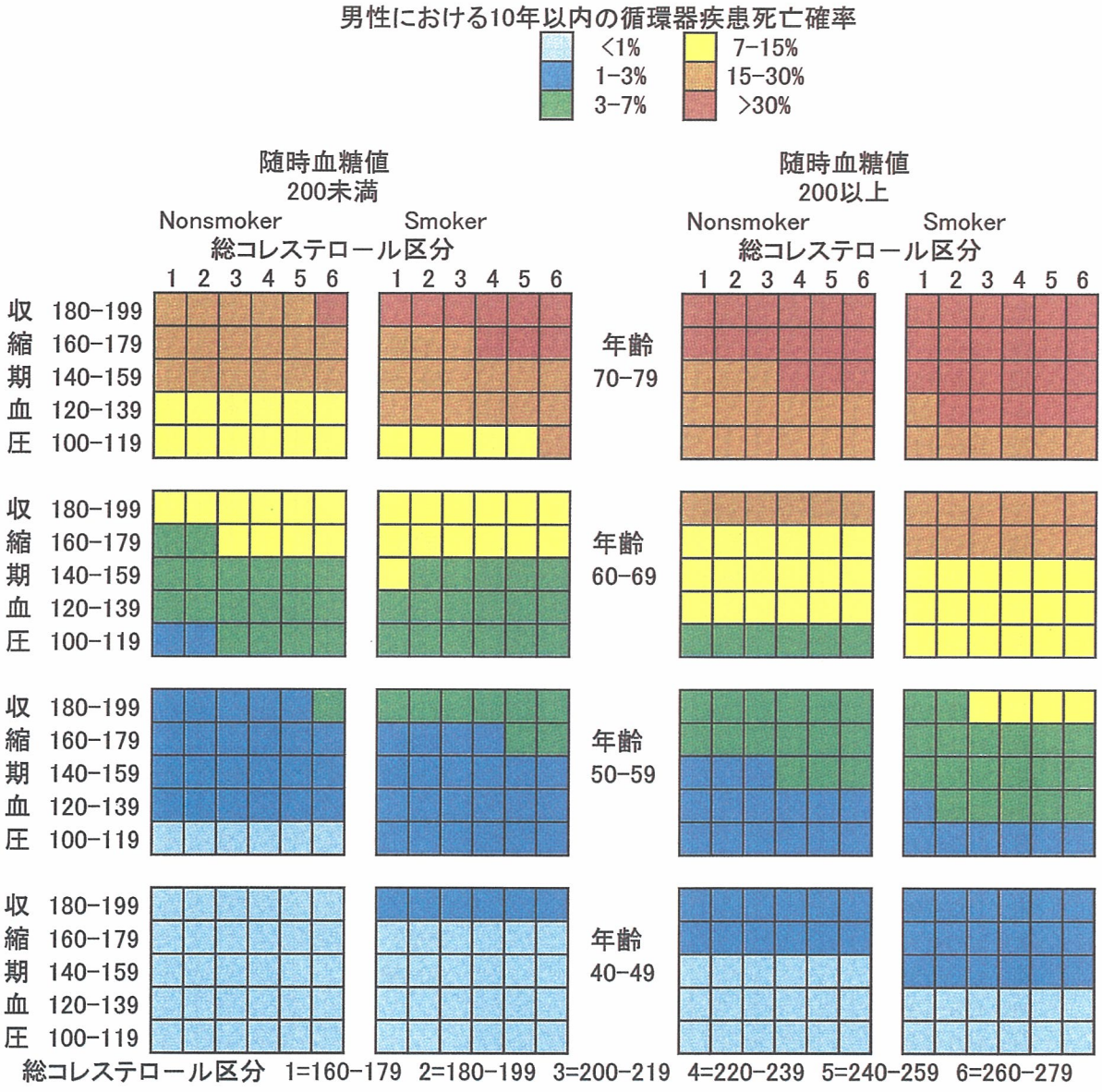

図 5. 循環器疾患健康度評価チャートー男性ー

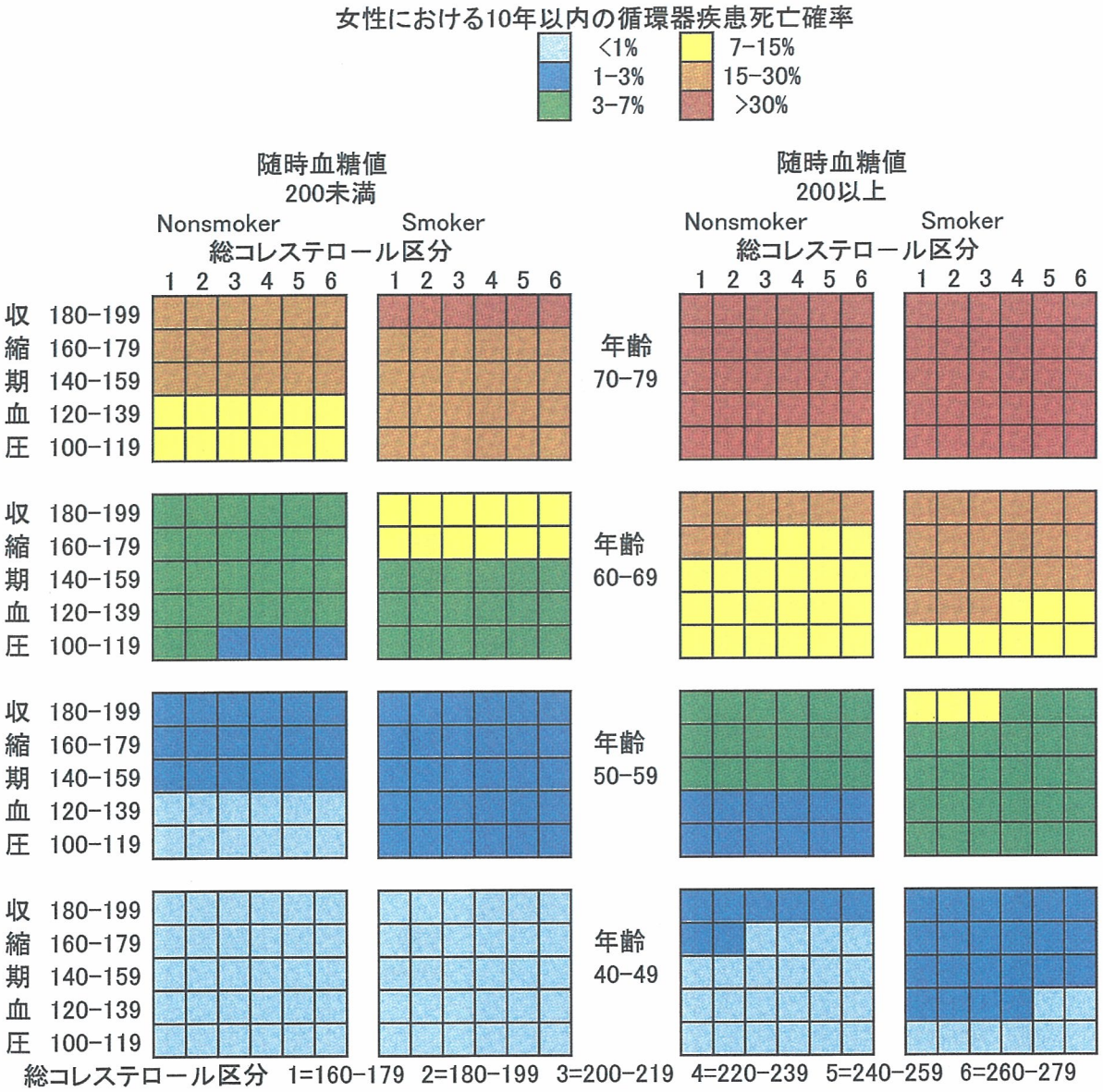

図 6. 循環器疾患健康度評価チャートー女性ー

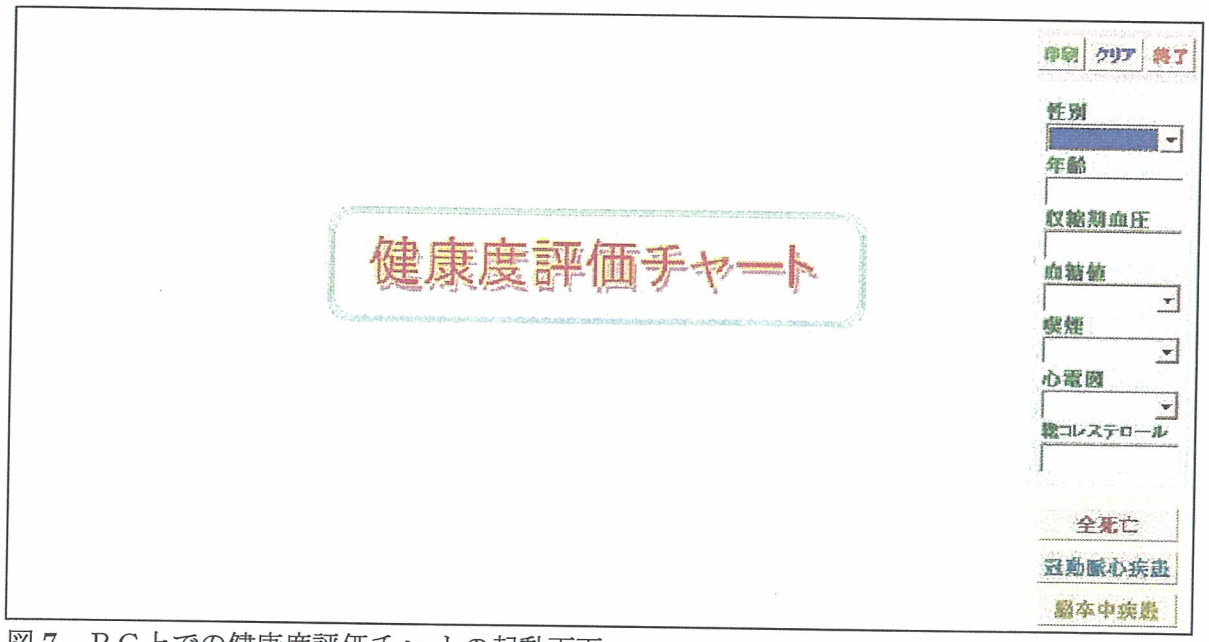

図 7. ＰＣ上での健康度評価チャ-トの起動画面

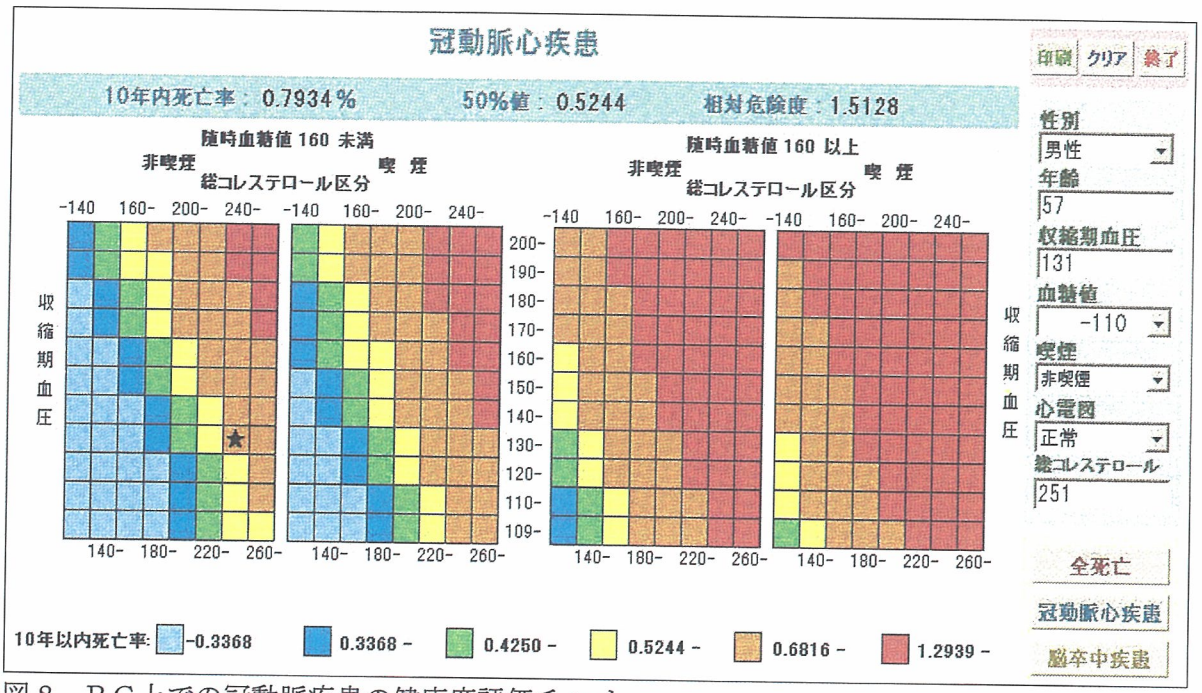

図 8. ＰＣ上での冠動脈疾患の健康度評価チャ-ト

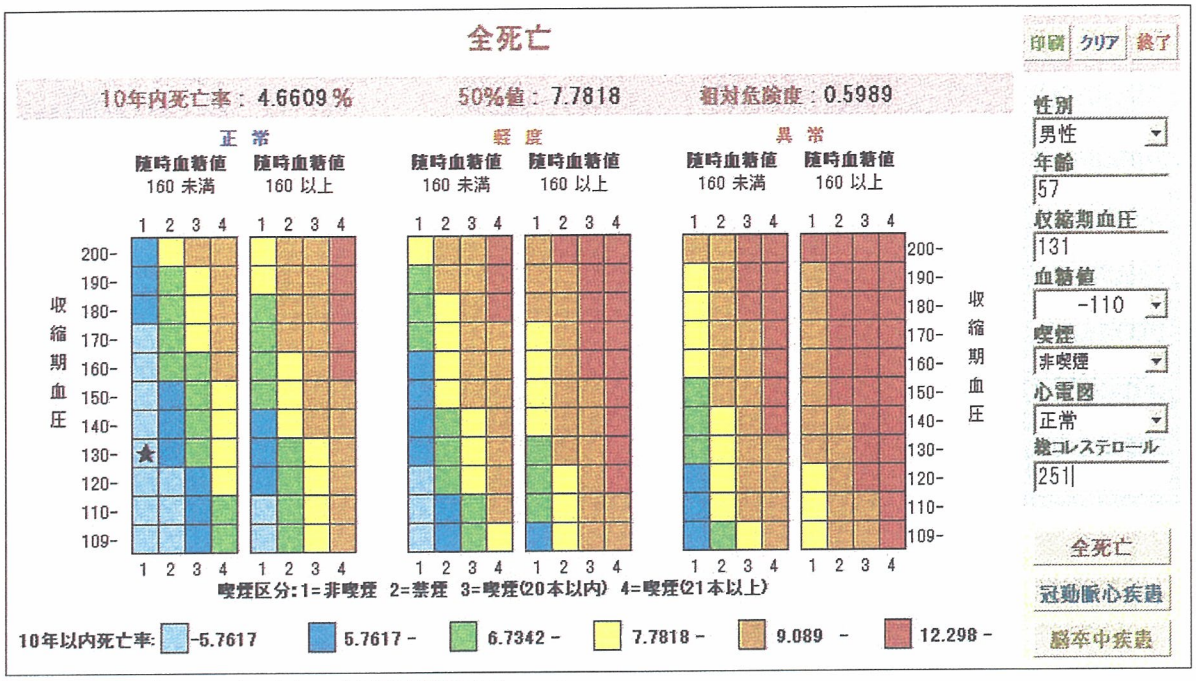

図 9. ＰＣ上での全死亡の健康度評価チャート

NIPPON DATA80 の 19 年間の追跡調査より作成した循環器疾患に対する危険度評価チャート

NIPPON DATA80 研究グループ

フラミンガム・スタディをはじめ、循環器疾患の危険因子の状態に基づき、循環器疾患への罹患危険度を評価するものが知られている。しかし、フラミンガム・スタディのスコアを用いて、国民の心筋梗塞や脳卒中発症率を予測することは、相対危険度としては可能であっても、絶対危険度としては予測することができない。そのため、わが国の疾病構造にあったものが必要であり、国民を代表する集団での健康危険度評価システムの開発が必要であった。

NIPPON DATA80 は 1980 年の循環器疾患基礎調査対象者、約 1 万人を追跡している調査であり、この 19 年間の追跡調査より、個人の循環器疾患の危険因子の状態に応じて、10 年間における心筋梗塞死亡、脳卒中死亡、全循環器疾患死亡等の確率について性別、年齢別に色分けしたチャートを作成した。ここで、10 年間の循環器疾患死亡確率の計算に用いた危険因子は、性、年齢、血圧値、血清総コレステロール値、随時採血時の血糖値、喫煙、である。

こチャートは、性別、10 歳年齢区分別に、血圧 5 群、血清総コレステロール値 6 群、喫煙の有無、糖尿病の有無別に 10 年間におけるそれぞれの循環器疾患死亡危険度が色分けして示されている。検査所見より循環器疾患死亡危険度が高くても、禁煙や血圧コントロール等により、その危険度の期待される低下が目に見える形でわかる。これらのチャートは、臨床の現場において、また、健診後の事後指導の現場において、対象者にわかりやすく予防と治療の重要性を認識してもらうための補助教材として有用であると期待している。

公表論文　NIPPON DATA80 Research Group. Circulation Journal 2006;70:1249-1255.

Circ J 2006; **70:** 1249–1255

Risk Assessment Chart for Death From Cardiovascular Disease Based on a 19-Year Follow-up Study of a Japanese Representative Population

— NIPPON DATA80 —

NIPPON DATA80 Research Group*

Background Based on the NIPPON DATA80, risk charts for the probability of death from coronary heart disease (CHD), stroke, and all cardiovascular disease (CVD) were constructed by sex and 10-year age groups.

Methods and Results The 9,638 participants were followed-up for 19 years from 1980, excluding 28 individuals without the necessary baseline data and 257 participants with past history of stroke or CHD. Final analysis was performed on 9,353 participants (4,098 men, mean age 50.3 years; 5,255 women, mean age 50.8) using a Cox proportional hazards model. Death probabilities over a 10-year period from CHD, stroke, and all CVD were calculated and displayed as color coding on each chart by combining 10-year age, systolic blood pressure, smoking, and serum total cholesterol and glucose levels. Six different colors corresponding to probabilities of death were displayed on each chart.

Conclusions The original charts based on the findings from NIPPON DATA80 are suitable for assessing CHD, stroke, and all CVD death risk in the general Japanese population. These charts should be used as a health-education tool for lifestyle modification targeting individuals with CVD risk factors. (*Circ J* 2006; **70:** 1249–1255)

Key Words: Blood pressure; Cholesterol; Coronary heart disease; Glucose; Smoking; Stroke

A 19-year follow-up study of a Japanese representative population, NIPPON DATA80, revealed that risk factors for stroke, coronary heart disease (CHD), and all cardiovascular disease (CVD) were not different from those of Western societies[1–4] although absolute risks for stroke and CHD in Japan were different[1–4] mainly due to differences in incidence and mortality from stroke and CHD.[5–10] Japanese individuals had the highest rate of stroke mortality in the world in 1965 but the lowest CHD incidence and mortality among industrialized countries.[5–10]

For assessing an individual's risk of stroke, CHD, and all CVD, Framingham CHD risk score, and New Zealand and European charts have been formulated and are now tools used in patient education.[4,11–13] However, a risk assessment chart or score for the Japanese population is necessary because of the differences in CVD morbidity and mortality.

NIPPON DATA80 is a 19-year follow-up study of mortality from stroke, CHD, and all CVD in about 10,000 representative Japanese men and women aged 30 years and older. The purpose of the present study was to construct risk-assessment charts for death from CHD, stroke, and all CVD based on NIPPON DATA80.

Methods

Population and Follow-up

Complete details of the NIPPON DATA80 study population have been described elsewhere.[1–3,14] Subjects of this cohort were participants in the 1980 National Survey on Circulatory Disorders.[1–3] A total of 10,546 community-based subjects aged 30 years and older in 300 randomly selected health districts throughout Japan participated in the survey. The survey consisted of history-taking, physical examinations, blood tests, and a self-administered questionnaire on lifestyle, including an essential nutrition survey using the food-frequency method. The overall population aged 30 years and older in the 300 participating health districts was 13,771, and the participation rate in the survey was 76.6% (10,546/13,771), before exclusion for the reasons below. We were able to follow-up 9,638 participants for 19 years, excluding 28 individuals without the necessary baseline data and 257 participants with a past history of stroke or CHD. Thus, we analyzed data from 9,353 participants (4,098 men, mean age 50.3 years; 5,255 women, mean age 50.8) for this study.

To determine cause of death in participants whot died during follow-up, we used the National Vital Statistics. In accordance with Japan's Family Registration Law, all death certificates issued by physicians are forwarded to the Ministry of Health and Welfare via the public health centers in the district of residency. Underlying causes of death were coded according to the 9th International Classification of Disease for the National Vital Statistics until the end of 1994, and according to the 10th International Classification of Disease from the beginning of 1995.[15] We confirmed deaths in each district by computer-matching of data from the Vital Statistics database, using the district, sex, and dates of birth and death as key codes.

Permission to use the National Vital Statistics was obtained from the Management and Coordination Agency, of

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Table 1 Baseline Characteristics of the Study Subjects in 1980, Number of Death From Stroke, Coronary Heart Disease and All Cardiovascular Disease During 19-Year Follow-up, NIPPON DATA80

	Men	Women
No. of subjects	4,098	5,255
No. of deaths from stroke	162	150
No. of deaths from coronary heart disease	67	65
No. of deaths from all cardiovascular disease	339	339
Age (years)	50.3±13.1	50.8±13.3
Systolic blood pressure (mmHg)	138.4±20.8	133.9±21.4
Total cholesterol (mg/dl)	186.1±32.7	190.8±34.1
Blood glucose (mg/dl)	101.0±32.4	99.6±28.7
% of those having glucose ≥200 mg/dl	1.61	1.16
Smoker (%)	63.3	8.8

the national government of Japan. Approval for this study regarding ethics issues was obtained from the Institutional Review Board of the Shiga University of Medical Science (No. 12–18, 2000).

Biochemical and Baseline Examinations

Baseline examinations were conducted by public health centers. Baseline systolic and diastolic blood pressures (SBP, DBP) were measured by trained operators using a standard mercury sphygmomanometer on the right arm of seated subjects after at least 5 min of rest.

Subjects were asked to note whether they were current smokers, had quit smoking, or had never smoked. Smokers were asked to note the number of cigarettes smoked each day. Non-fasting blood samples were drawn and centrifuged within 60 min of collection, and then stored at −70°C until analyses. Total cholesterol was analyzed in a sequential auto-analyzer (SMA12/60; Technicon, Tarrytown, NY, USA) at a single laboratory (Osaka Medical Center for Health Science and Promotion), which is a member of the Cholesterol Reference Method Laboratory Network (CRMLN),[16] and the precision and accuracy of the measurements of serum cholesterol were certified in the Lipid Standardization Program administered by the Centers for Disease Control and Prevention, Atlanta. Serum concentration of glucose was measured by the cupric-neocuproine method.[17] Original glucose values obtained by the cupric-neocuproine method were converted to those of the glucose-oxidase method, which is currently the standard, by use of an equation reported by the same laboratory.[18] Diabetes mellitus (DM) was defined as a serum glucose concentration ≥200 mg/dl.

Statistical Analysis

Complete details of the statistical methods are reported elsewhere.[19] The outcome event used in the present study was cause-specific death from stroke, CHD, and all CVD. A Cox proportional hazards model was used to determine the probability of death of those with risk factor x at baseline. Survival probability $S(t:x)$ at the time t for risk factor x in the Cox regression analysis is given as the following: $S(t:x)=[S_0(t:\bar{x})]^{\exp(\beta(\bar{x}-x))}$, where $\bar{x}$ is population mean of risk factor x, and $S_0(t:\bar{x})$ is survival probability for those with risk factor $\bar{x}$. The 10-year probability of death for risk factor x was calculated by the following equation: $1-S(10:x)$.

We constructed risk assessment charts for 10-year probability of death due to CHD, stroke, and all CVD in both men and women using traditional risk factors (ie, SBP, smoking habit, serum total cholesterol and serum glucose). SBP was classified into 5 categories: (1) 100–119 mmHg, (2) 120–139 mmHg, (3) 140–159 mmHg, (4) 160–179 mmHg and (5) 180–199 mmHg. Smoking was divided into 2 categories: non-current smoker and current smoker. Serum total cholesterol was classified into 6 categories: (1) 160–179 mg/dl, (2) 180–199 mg/dl, (3) 200–219 mg/dl, (4) 220–239 mg/dl, (5) 240–259 mg/dl, and (6) 260–279 mg/dl. Casual serum glucose level was divided into 2 categories: <200 mg/dl and ≥200 mg/dl. These cut-off points were based on either practical considerations or guideline recommendations from the Hypertension Treatment Guidelines 2004 in Japan and the Treatment of Atherosclerosis in Japan.[20,21] Ten-year death probabilities from stroke, CHD, and all CVD were calculated and displayed as color coding on each chart, combining 10-year age, systolic blood pressure, smoking, and serum total cholesterol and glucose levels. Six different colors were displayed on each chart corresponding to the following probabilities of death: <0.5%, 0.5–1%, 1–2%, 2–5%, 5–10% and ≥10% for CHD and stroke, and <1.0%, 1–3%, 3–7%, 7–15%, 15–30% and ≥30% for all CVD. SAS version 8.02 for Windows (SAS Institute, Cary, NC) was used for estimating a regression coefficient of, and the survival probability $S_0(t:\bar{x})$ for those with the population mean $\bar{x}$ of a risk factor.

Results

During the 19-year follow-up from 1980, the number of deaths from stroke and CHD was 312 and 132, respectively (Table 1), and death rates were 1.93 and 0.81 per 1,000 person-years. Average age for men and women at baseline was 50.3 and 50.8 years, respectively. Although SBP was higher in men than in women, serum total cholesterol was higher in women than in men (190.8 mg/dl vs 186.1 mg/dl). Prevalence of casual glucose level ≥200 mg/dl was slightly higher in men than in women (1.61% vs 1.16%). Smoking rate in men was far greater than in women, reflecting the relatively high smoking rate of Japanese men in 1980.

Table 2 Age-Specific Mortality per 1,000 Person-Years, 19-Year Follow-up, NIPPON DATA80

Age (years)	Stroke		CHD		All CVD	
	Men	Women	Men	Women	Men	Women
30–39	0.15	0.12	0.05	0.00	0.35	0.20
40–49	0.35	0.32	0.50	0.12	1.09	0.68
50–59	1.73	0.76	0.80	0.22	3.83	1.69
60–69	5.57	2.77	2.07	1.89	10.81	6.97
≥70	18.43	14.30	6.06	5.28	37.61	31.33

CHD, coronary heart disease; CVD, cardiovascular disease.

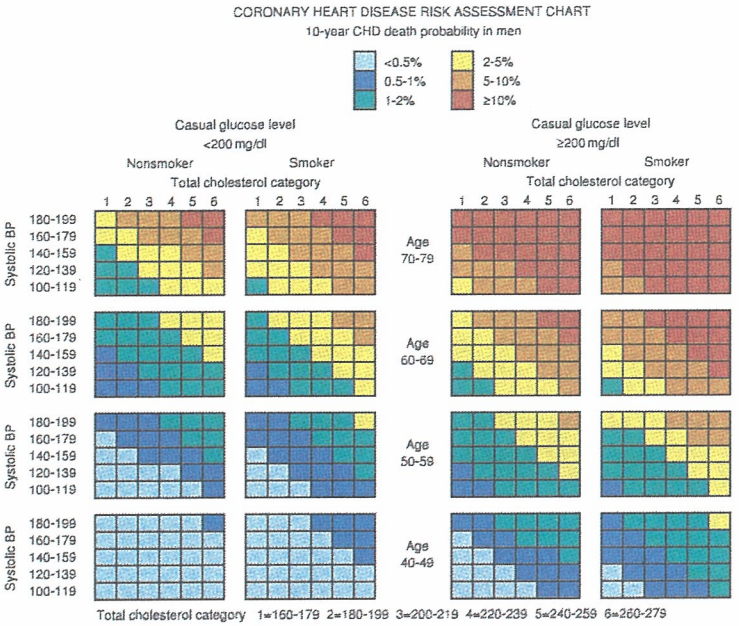

Fig 1. Risk assessment chart for 10-year probability of death due to coronary heart disease in men, NIPPON DATA80. Ten-year probability of death was calculated based on individual risk assessment using sex, age, systolic blood pressure (BP), serum total cholesterol, serum glucose and smoking habit. Someone with any of the cardiovascular disease risk factors, despite belonging to the lowest risk group (light blue) should undergo risk factor modification by non-pharmacological and/or pharmacological treatment. CHD, coronary heart disease.

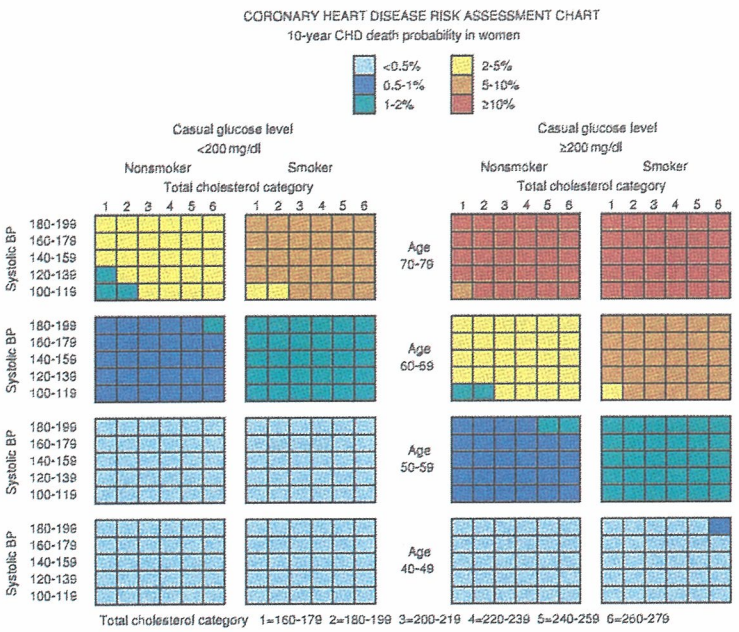

Fig 2. Risk assessment chart for 10-year probability of death due to coronary heart disease in women, NIPPON DATA80. Ten-year probability of death was calculated based on individual risk assessment using sex, age, systolic blood pressure (BP), serum total cholesterol, serum glucose and smoking habit. Someone with any of the cardiovascular disease risk factors, despite belonging to the lowest risk group (light blue) should undergo risk factor modification by non-pharmacological and/or pharmacological treatment. CHD, coronary heart disease.

Death rates for stroke and CHD by age group at entry in 1980 are shown in Table 2. Stroke death rate was around 3-fold higher than the CHD death rate among subjects aged 70 years and older. Stroke mortality for men increased with age; however, CHD mortality rate after the age of 70 years was similar for both sexes, although the mortality rate was much higher in men than in women under the age of 70.

A Cox proportional hazards model was used to determine 10-year probability of death due to CHD, stroke, and all CVD, taking into account baseline risk factors such as age, SBP, serum total cholesterol, smoking, and serum glucose. By using the coefficients from the Cox model and the 10-year death probability for mean levels of risk factors (age, smoking, total cholesterol and casual glucose), risk assessment charts were constructed for both sexes for the probability of death within 10 years from CHD, stroke, or all CVD. The 10-year probability of death was determined for various combinations of baseline risk-factor levels. Figs 1–6 show the results, with a 6-color gradient from the highest (red) to the lowest (light blue) probability of death within 10 years.

In Fig 1 for male CHD risk assessment, if a man aged 65 years had a SBP of 164 mmHg, a smoking habit, a glucose level of 210 mg/dl, and a serum total cholesterol of 240 mg/dl, his CHD death probability within 10 years would be ≥10%, as shown in red. If this subject quit smoking without any other risk factor changes, his CHD death probability would be <10%, as shown by the yellow-brown color.

The chart for 10-year stroke death probability was some-

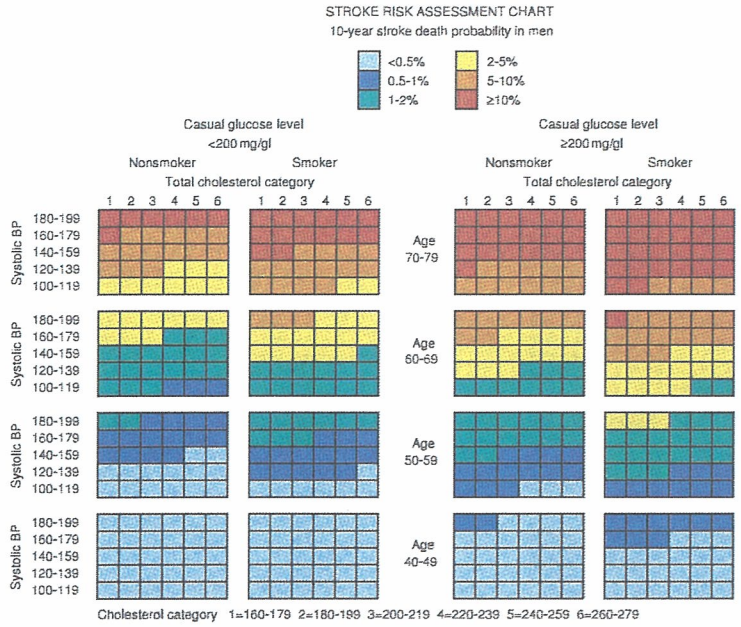

Fig 3. Risk assessment chart for 10-year probability of death due to stroke in men, NIPPON DATA80. Ten-year probability of death was calculated based on individual risk assessment using sex, age, systolic blood pressure (BP), serum total cholesterol, serum glucose and smoking habit. Someone with any of the cardiovascular disease risk factors, despite belonging to the lowest risk group (light blue) should undergo risk factor modification by non-pharmacological and/or pharmacological treatment.

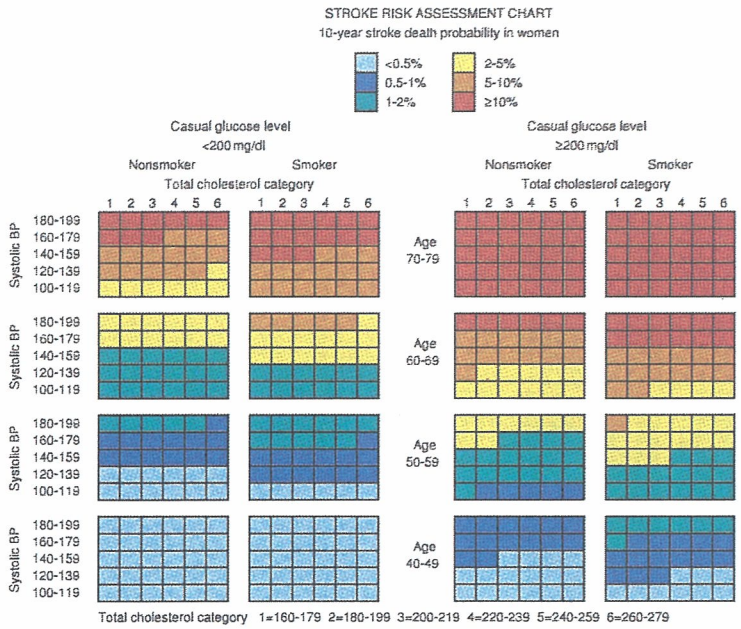

Fig 4. Risk assessment chart for 10-year probability of death due to stroke in women, NIPPON DATA80. Ten-year probability of death was calculated based on individual risk assessment using sex, age, systolic blood pressure (BP), serum total cholesterol, serum glucose and smoking habit. Someone with any of the cardiovascular disease risk factors, despite belonging to the lowest risk group (light blue) should undergo risk factor modification by non-pharmacological and/or pharmacological treatment.

what different from the CHD death probability chart for both men and women. For CHD death the color (probability) gradient continued from the lower-left to the upper-right, whereas the color gradient for stroke death was not as remarkable as it was for CHD. For all CVD, the chart was a cross between the charts for death risk due to CHD and to stroke. Again, the color gradient tended to proceed from the lower-left to the upper-right, although this gradient was weaker in all CVD than in CHD.

Discussion

Based on a 19-year follow-up study in a Japanese representative population, we constructed 10-year death probability charts for CHD, stroke, and all CVD, with a 6-color gradient showing 10-year probability of death. A major strength of these charts is that the risk of death was estimated using traditional risk factors based on a cohort study of a representative Japanese population. Our original charts created in this study may be more suitable in terms of generalization for Japanese people than others based on the modified Framingham CHD risk core, or a local cohort study,[4,11–13,22] although these charts also contained a high-density lipoprotein cholesterol variable.

The risk assessment charts presented here show 10-year death probabilities, but not incidence probability. Therefore, the absolute death rate in these charts is lower than that of incidence. However, using a 6-color gradient from the highest (red) to the lowest (light blue) probability of death allows individuals to see their own position on the chart

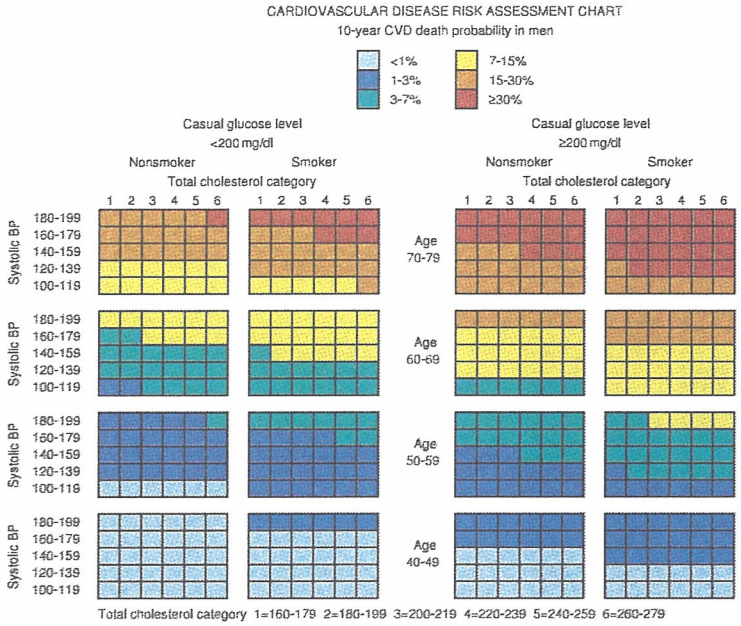

Fig 5. Risk assessment chart for 10-year probability of death due to all cardiovascular disease in men, NIPPON DATA80. Ten-year probability of death was calculated based on individual risk assessment using sex, age, systolic blood pressure (BP), serum total cholesterol, serum glucose and smoking habit. Someone with any of the cardiovascular disease (CVD) risk factors, despite belonging to the lowest risk group (light blue) should undergo risk factor modification by non-pharmacological and/or pharmacological treatment.

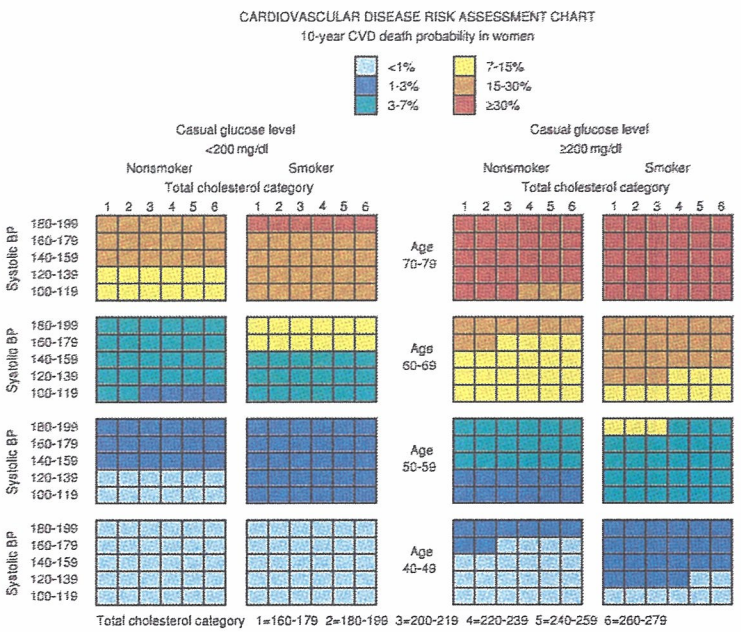

Fig 6. Risk assessment chart for 10-year probability of death due to all cardiovascular disease in women, NIPPON DATA80. Ten-year probability of death was calculated based on individual risk assessment using sex, age, systolic blood pressure (BP), serum total cholesterol, serum glucose and smoking habit. Someone with any of the cardiovascular disease (CVD) risk factors, despite belonging to the lowest risk group (light blue) should undergo risk factor modification by non-pharmacological and/or pharmacological treatment.

and easily understand their own risk level.

We estimated risk using an age range of 40–79 years and found that men and women in their 40s and 50s had a lower probability of death even if they had traditional risk factors (ie, smoking and hypertension). In contrast, men and women in their 70s had the highest probability of death (yellow, orange and red colors). If we had performed separate risk analysis on each 10-year age range, we could have identified the risk within any given 10-year age range. However, in this study, we followed a similar method of risk assessment as the Framingham CHD risk assessment score[4] and others.[1,2] It should be understood that the charts presented here do not alleviate the need to control risk factors in younger individuals, despite their lower probability of death. For example, hypertension should be controlled in everyone by lifestyle modification, and by drug treatment, if necessary. If we ignore hypertension in younger individuals because of their lower risk of mortality from CHD and stroke, such individuals will have increased risk of mortality as they age. This principle also applies to modification of all traditional risk factors, such as high serum cholesterol, smoking, and DM.

Many epidemiologic studies in Japan, including NIPPON DATA80 and 90, have revealed risk factors for stroke, CHD, all heart disease, and all CVD.[1–3,14,18,20–32] These risks for a specific disease are shown as either relative or absolute. Although absolute and relative risks are useful for health education, the risk assessment charts developed in this study should provide an improved health-education tool. A health professional can give more effective health

education to individuals using the charts rather than simply informing them of their relative or absolute risk of dying from a particular disease.

The CHD risk assessment chart resulting from this study was clearly graded but the stroke chart was not, mainly because serum total cholesterol was not a risk factor for stroke death, which has has been well documented in several cohort studies[2,26,29,33–35] As an epidemiological finding, stroke incidence and mortality in the general Japanese population varied directly with blood pressure but inversely with total serum cholesterol levels[2,6–8,10,14,20,21,24,28,29,33–35]

In conclusion, our risk assessment charts by sex for CHD, stroke, and all CVD can be used as a health-education tool to show risk of death in Japanese individuals. We hope that these charts are used not only in the clinic but also in the community and industrial health sectors.

Acknowledgments

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Appendix 1

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NIPPON DATA80: National Integrated Project for Prospective Observation of Non-Communicable Disease And its Trends in the Aged

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血圧水準と循環器疾患

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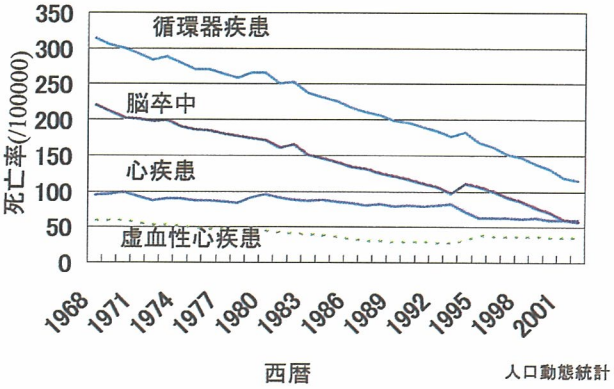
1. 循環器の最大危険因子としての高血圧とその動向

1960年代には我が国は脳卒中死亡率（年齢調整値）が極めて高く、その後劇的に減少した。現在では我が国の脳卒中死亡率は先進諸国の中でもほぼ平均的な値となっている。図1には30－69歳の男性壮年期について人口動態統計から循環器疾患、脳卒中、虚血性心疾患および心疾患の死亡率の推移を示した。循環器疾患死亡率は1968年の人口10万人あたり314人から2002年の115人まで約3分の1に減少している。循環器疾患死亡率が激減した背景には過半を占める脳卒中死亡率が人口10万人あたり210人から56人まで約4分の1に減少したことが背景にある。

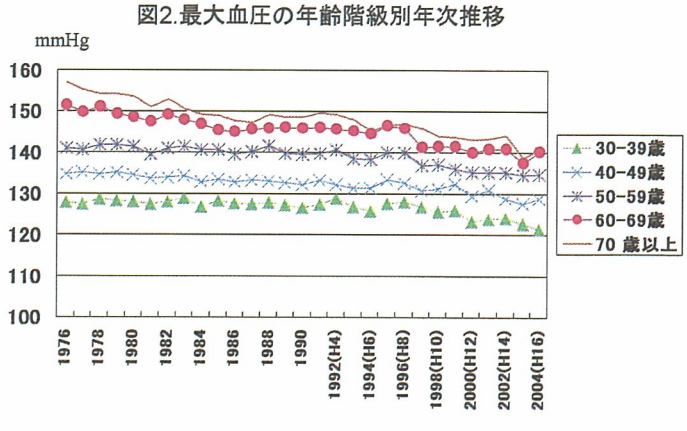
図1．年齢調整死亡率の年次推移
（30－69歳）



特筆すべき点は脳卒中死亡率が低下したばかりでなく虚血性心疾患死亡が減少した点である。1968年に人口10万人あたり57人だった死亡率が2002年には34人まで減少している。我が国は脳卒中の劇的な減少と虚血性心疾患死亡率の減少を同時に達成した世界でもまれな存在といえる。総死亡率の減少のうち循環器疾患死亡率の低下により約50%が説明可能であり、循環器疾患死亡率の低下が日本人の寿命の延伸に大きく寄与したといえる。その結果日本は世界で最も長寿とされる国となった。

人口動態統計で用いられる国際疾病分類が第8版（1968-1982年）、9版（1983－1994年）、10版（1995年-）と変更されるたびに人口動態統計の基礎となる死亡診断書は、より明確な死因を求められるようになった。その結果、各改訂の後に脳卒中や虚血性心疾患の死亡率は上昇している。このことを考慮に入れると脳卒中や虚血性心疾患死亡率の実際の減少はもっと多い可能性がある。

図2.最大血圧の年齢階級別年次推移



（出典：国民栄養調査）

こうした脳卒中と虚血性心疾患死亡率低下の背景として考えられているのが共通の

危険因子である高血圧有病率の減少である。

図2は毎年国民から無作為抽出された集団に対し実施されている国民栄養調査(1980年、1990年、2000年には同時に循環器疾患基礎調査を実施）の結果から男性の年齢階級別の最大血圧の平均値の推移を見たものである（出典：健康日本21中間評価)。1976年には70歳以上の高齢者では最大血圧の平均が157mmHgに達していた。年齢が若くなるに従って60歳代では152mmHg、50歳代で141mmHg, 40歳代で135mmHg、更に30歳代では128mmHgと低い傾向が見られた。これをまとめると10歳毎に約5mmHg高くなる傾向が見られた。図に示すとおり年度が新しくなるにつれ全ての年齢層で最大血圧の平均が低下していることがわかる。70歳以上では16mmHg、60歳代で11mmHg、30−50歳代でも6mmHgの低下が観察されている。健康日本21で示されたように集団の最大血圧の平均が1mmHg低下すると脳卒中死亡率は2%、虚血性心疾患死亡率は1%低下することを考えると、この血圧の低下が脳卒中死亡率低下や虚血性心疾患死亡の低下に大きく寄与したと考えられている。しかし最近の国民栄養調査の成績をみると最大血圧はほぼ横ばいであり、血圧の低下を反映した循環器疾患死亡率の低下が今後も続くかどうか予断を許さない（健康日本21中間評価)。ここでは最大血圧、最小血圧および血圧区分別に高血圧の脳卒中、心疾患、循環器疾患および総死亡への健康影響を代表集団である循環器疾患基礎調査受診者約1万人を追跡したNIPPON DATA80の成果を中心に概括する。

2. 最大血圧（１４年追跡から）

表1 最大血圧区分別の総死亡、循環器疾患、心疾患および脳卒中の年齢調整相対危険度(95%信頼区間)。P値は線形性の検定結果を示す。

	-119mmHg	120-129mmHg	130-139mmHg	140-159mmHg	160-179mmHg	180mmHg-	p値
男性							
総死亡	1	1.10 (0.75- 1.61)	1.08 (0.76- 1.54)	1.17 (0.84- 1.63)	1.33 (0.94- 1.88)	1.78 (1.20- 2.64)	>0.001
循環器疾患	1	1.74 (0.74- 4.10)	2.10 (0.96- 4.62)	2.39 (1.12- 5.10)	3.01 (1.45- 6.27)	4.65 (2.25- 9.63)	>0.001
心疾患	1	8.43 (1.51- 47.2)	9.68 (1.49- 63.1)	13.43 (2.07- 87.1)	25.45 (2.74- 237)	115.34 (9.89- 1345)	0.017
脳卒中	1	0.56 (0.18- 1.79)	0.99 (0.40- 2.45)	1.10 (0.47- 2.61)	1.65 (0.73- 3.75)	2.61 (1.15- 5.96)	>0.001
女性							
総死亡	1	1.21 (0.86- 1.71)	1.07 (0.76- 1.51)	1.40 (1.03- 1.90)	1.44 (1.02- 2.03)	2.14 (1.46- 3.13)	0.222
循環器疾患	1	1.83 (1.04- 3.25)	1.03 (0.55- 1.93)	1.52 (0.90- 2.57)	2.05 (1.22- 3.44)	2.74 (1.61- 4.67)	0.069
心疾患	1	1.60 (0.76- 3.37)	0.96 (0.44- 2.07)	0.94 (0.46- 1.93)	1.65 (0.82- 3.32)	1.50 (0.64- 3.52)	0.77
脳卒中	1	3.17 (1.17- 8.57)	1.46 (0.45- 4.66)	2.87 (1.17- 7.05)	3.40 (1.45- 7.97)	5.42 (2.59- 11.3)	0.037

NIPPON DATA80１４年追跡の結果から最大血圧区分別の脳卒中、心疾患、循環器疾患および総死亡の120mmHg未満を基準とした各区分の相対危険度を表1に示した。降圧剤治療の有無は考慮していない。男性の脳卒中では120-129mmHg未満がもっとも低いが、全体としては最大血圧の区分が高くなるほど相対危険度が有意に上昇していた。この傾向は女性でも同様であった。心疾患では男性で最高血圧区分が上昇するほど相対危険度が急激に上昇しており、線形性の検定の結果も有意であった。最高血圧区分のもっとも低い区分では死亡件数が少なかったため各最高血圧区分の相対危険度は信頼区間が広い傾向を示した。これに対して女性では心疾患死亡率の相対危険度と最高血圧区分はほとんど関連がみられなかった。その理由として女性では心疾患に占める虚血性心疾患

の比重が少なく心不全の割合が高いこと、心不全にはその他の死因が少なからず含まれている可能性があることが考えられた。

循環器疾患では男性では最高血圧区分がもっとも低い区分でもっとも死亡率が低く、区分が高くなるにつれ相対危険度が高くなる傾向が見られ、もっとも低い区分と比較して4.65倍を示した。女性でも傾向は同様であったが最高血圧区分との関連は男性ほど明瞭ではない。線形性の検定の結果もボーダーラインであった。

総死亡で男性では区分が高くなるほど相対危険度が上昇し、線形性の検定の結果有意であったが、区分別ではもっとも高い区分のみが有意に上昇していた。女性では140mmHg以上の最高血圧区分で相対危険度が有意に上昇していたが、線形性の検定結果では関連は有意ではなかった。

以上から最高血圧区分は脳卒中では男女ともに有意な線形な関連を示したが、女性では心疾患でほとんど関連がみられなかった。循環器疾患や総死亡も男性の方が関連が明らかであった。表２には最高血圧以外の主要な危険因子を調整した男女別の最大血圧10mmHg上昇あたりの相対危険度を示した。男性では脳卒中、心疾患、循環器疾患でほ

表2. 最大血圧10mmHg上昇あたりの総死亡、循環器疾患、心疾患および脳卒中死亡の多変量調整相対危険度(R.R.)＊及び95％信頼区間(NIPPON DATA 14年追跡による)

	男性		女性	
	R.R.	(95% 信頼区間)	R.R.	(95% 信頼区間)
総死亡	1.09	(1.05- 1.12)	1.04	(1.00- 1.08)
循環器疾患	1.16	(1.10- 1.23)	1.07	(1.01- 1.14)
心疾患	1.15	(1.06- 1.25)	1.01	(0.93- 1.10)
脳卒中	1.18	(1.09- 1.28)	1.14	(1.05- 1.23)

*: コックス比例ハザードモデルによる重回帰モデルでは喫煙習慣、飲酒習慣、血清総コレステロール、糖尿病の有無、BMIを調整した。

ぼ同様の相対危険度を示した。総死亡では1.09倍と有意な関連を示した。女性では脳卒中、循環器疾患、総死亡で有意な関連が示されたが、相対危険度は男性より低い傾向であった。脳卒中、循環器疾患や総死亡で女性での関連が少ない理由として、今回の分析では治療の有無にかかわらず、測定値を用いたことが考えられる。女性では血圧の治療者の割合が男性に比して高く、その時点での血圧が必ずしも将来の血圧を予測しているとは限らないことが背景にあると考えられる。

3. 最小血圧（１４年追跡から）

表3. 最小血圧区分別の総死亡、循環器疾患、心疾患および脳卒中の年齢調整相対危険度(95%信頼区間)。P値は線形性の検定結果を示す。

	-74mmHg	75－84mmHg	85－94mmHg	95－104mmHg	105mmHg－	p値
男性						
総死亡	1	0.88 (0.71- 1.09)	0.92 (0.74- 1.14)	1.06 (0.82- 1.37)	1.42 (1.02- 1.97)	0.13
循環器疾患	1	0.87 (0.60- 1.27)	1.20 (0.84- 1.72)	1.51 (0.98- 2.31)	1.95 (1.13- 3.35)	0.007
心疾患	1	0.87 (0.52- 1.47)	0.96 (0.57- 1.61)	1.21 (0.65- 2.27)	1.87 (0.86- 4.07)	0.007
脳卒中	1	0.89 (0.50- 1.58)	1.53 (0.91- 2.58)	2.10 (1.14- 3.85)	2.32 (1.08- 4.98)	0.001
女性						
総死亡	1	1.02 (0.83- 1.25)	0.93 (0.74- 1.16)	1.12 (0.83- 1.52)	1.98 (1.39- 2.81)	0.02
循環器疾患	1	1.18 (0.84- 1.65)	1.06 (0.74- 1.54)	1.59 (1.02- 2.46)	3.05 (1.89- 4.92)	0.001
心疾患	1	0.91 (0.58- 1.44)	0.84 (0.51- 1.37)	1.20 (0.64- 2.23)	1.17 (0.46- 2.98)	0.52
脳卒中	1	1.57 (0.92- 2.67)	1.13 (0.61- 2.07)	2.37 (1.26- 4.44)	5.84 (3.18- 10.7)	<0.001

表３には最小血圧区分別の相対危険度を示した。脳卒中では最小血圧区分が75-84mmHg でもっとも相対危険度がちいさかったが、それ以外では区分が高くなるほど相対危険度が大きくなる傾向が見られ、95mmHg 以上の区分で有意に相対危険度が上昇しており、線形性の検定の結果も有意であった。女性でもほぼ同様な結果を示し95mmHg 以上の区分で有意に上昇し、線形性の検定結果も有意であった。心疾患では最小血圧が 95mmHg 以上で相対危険度が大きくなる傾向が見られたが単独で有意な区分はみられなかった。女性では明らかな関連はみられなかった。

循環器疾患でも最小血圧区分が高くなるほど相対危険度が大きくなる傾向が見られ、男女ともに線形性の検定結果は有意であった。総死亡では男性では 105mmHg 以上の群のみで相対危険度は有意に大きかったが線形性の関連は有意ではなかった。女性でもほぼ同様であったが線形性の検定結果は有意であった。表４に多変量調整済み最小血圧5mmHg あたりの各死因別相対危険度を示した。男性ではすべての死因および総死亡で有意な関連がみられた。女性では脳卒中、循環器疾患、総死亡で有意な関連がみられ、心疾患では関連がみられなかった。以上をまとめると最小血圧も最大血圧と同様に循環器疾患と有意な関連がみられたが、男女差は心疾患をのぞき明らかではなかった。

表4.　最小血圧 5mmHg 上昇あたりの総死亡、循環器疾患、心疾患および脳卒中死亡の多変量調整相対危険度(R.R.)＊及び95%信頼区間(NIPPON DATA 14年追跡による)

	男性		女性	
	R.R.	(95% 信頼区間)	R.R.	(95% 信頼区間)
総死亡	1.04	(1.01- 1.08)	1.06	(1.02- 1.09)
循環器疾患	1.11	(1.05- 1.17)	1.11	(1.06- 1.17)
心疾患	1.08	(1.00- 1.17)	1.03	(0.95- 1.11)
脳卒中	1.15	(1.07- 1.24)	1.19	(1.10- 1.27)

*: コックス比例ハザードモデルによる重回帰モデルでは喫煙習慣、飲酒習慣、血清総コレステロール、糖尿病の有無、BMIを調整した。

4.　血圧区分別結果（１４年追跡から）

表5 血圧区分の総死亡、循環器疾患、心疾患及び脳卒中死亡への至適血圧区分を基準としたマンテルヘンツェル年齢調整相対危険度(NIPPON DATA80 14年追跡による)

	I	II	III	IV	V	VI	p
男性							
総死亡	1	1.01 (0.66- 1.53)	1.21 (0.82- 1.79)	1.07 (0.74- 1.56)	1.38 (0.95- 2.00)	1.63 (1.06- 2.51)	<0.001
循環器疾患	1	2.80 (0.87- 9.05)	3.97 (1.32- 11.94)	3.88 (1.30- 11.63)	6.65 (2.49- 17.73)	7.66 (2.71- 21.70)	<0.001
心疾患	1	5.25 (0.83- 33.01)	6.38 (0.88- 46.26)	7.68 (1.07- 55.23)	19.27 (2.86- 130.00)	32.28 (3.14- 332.00)	0.024
脳卒中	1	1.36 (0.27- 6.82)	2.62 (0.68- 10.11)	2.27 (0.60- 8.63)	3.70 (1.11- 12.28)	4.69 (1.42- 15.50)	<0.001
女性							
総死亡	1	1.33 (0.92- 1.93)	1.11 (0.75- 1.63)	1.58 (1.15- 2.18)	1.40 (0.97- 2.03)	2.36 (1.62- 3.45)	0.076
循環器疾患	1	1.73 (0.91- 3.29)	0.92 (0.44- 1.92)	1.82 (1.03- 3.20)	2.17 (1.23- 3.85)	3.22 (1.86- 5.60)	0.005
心疾患	1	1.62 (0.70- 3.72)	0.87 (0.35- 2.18)	1.23 (0.58- 2.61)	1.94 (0.89- 4.24)	1.87 (0.77- 4.53)	0.24
脳卒中	1	3.00 (0.95- 9.44)	1.28 (0.32- 5.14)	3.48 (1.29- 9.34)	3.28 (1.30- 8.26)	6.06 (2.80- 13.12)	0.004

I:至適血圧, II:正常血圧, III:正常高値血圧, VI: 軽症高血圧, V: 中等症高血圧, VI: 重症高血圧.

最高血圧や最大血圧の意義は直感的に理解しやすいが、降圧剤服用率が高い集団では、測定時条件により血圧値は大きく変動する可能性があり測定値の意義は明らかではない。ここでは降圧剤服用者を含む集団について血圧区分を用いて検討した結果を示した。血圧区分は ISH/WHO 合同委員会（1999 年）を用いた。降圧剤服用者で測定結果が高血圧（140/90mmHg）区分より下の血圧であったものは軽症高血圧区分に再割り当てを行った。高血圧区分の値についてはそのままの区分とした。表５には血圧区分別の脳卒中、心疾患、循環器疾患および総死亡の相対危険度を示した。相対危険度は理想血圧（120/80mmHg 未満）を基準として求めた。脳卒中は男性でも女性でも血圧区分が高くなるほど有意に大きくなり、男性では中等症高血圧区分以上、女性では軽症高血圧区分以上で有意にリスクが増加していた。

心疾患では最大血圧、最小血圧を単独で分析した結果と同様に男性では軽症高血圧区分以上で有意に上昇しており、線形性の検定結果も有意であったが、女性では明確ではなかった。循環器疾患では男性では正常高値血圧以降で有意にリスクが上昇し女性でも軽症高血圧区分以上で有意にリスクが上昇し、男女ともに線形性の検定結果は有意であった。総死亡では循環器疾患ほど明瞭な関連はみられなかったが、男性では線形性の検定の結果は有意であった。女性でも同様の傾向を示したが、ボーダーラインであった。

表６は多因子調整の血圧区分が１つ上昇する場合の多変量調整相対危険度を求めたものである。脳卒中では男性で 1.45 倍、女性でも 1.27 倍と有意に関連していた。心疾患死亡は男性のみで有意であった。循環器疾患死亡、総死亡は男女ともに有意に関連していた。

表6. 脳卒中、心疾患、循環器疾患および総死亡に対する、多変量調整（年齢、BMI, 総コレステル、糖尿病、喫煙および飲酒を調整）血圧区分別の相対危険度（RR）95%信頼区間（95% CI）。I: 適、II: 正常血圧、III: 正常高値血圧、IV:軽症高血圧,V: 中等症高血圧、VI:重症高血圧。

	男		女	
	R.R.	(95% CI)	R.R.	(95% CI)
総死亡	1.16	(1.09- 1.23)	1.09	(1.03- 1.17)
循環器疾患死亡	1.37	(1.23- 1.52)	1.18	(1.07- 1.31)
心疾患死亡	1.29	(1.11- 1.51)	1.12	(0.97- 1.28)
脳卒中死亡	1.45	(1.24- 1.69)	1.27	(1.09- 1.49)

5. 高血圧による脳卒中過剰死亡割合による評価

日本国民全体への血圧の脳卒中などへの影響を相対危険度のみでは十分評価することは困難である。相対危険度はある血圧値を持った個人のリスクを評価するには有用であるが、そうした個人が何人いるかで集団におけるリスクの大きさは異なるからである。そこで人口寄与危険割合の概念を用いて相対危険度を拡張して、高血圧の日本人への影響の強さを検討した。用いた相対危険度は最大血圧 10mmHg 上昇あたりの多変量調整相対危険度である（男性：1.18, 女性：1.14）。もっとも血圧区分の低い 120mmHg 未満の相対危険度を１として、各最大血圧区分別の相対危険度を計算した。相対危険度か

ら１を引いたのが寄与危険度で、その区分の有病率をかけることで、各最高血圧区分における過剰死亡割合が求められる。言い換えると血圧区分別過剰死亡割合とは最大血圧 120 mmHg 未満での過剰死亡割合を 0 として、各最大血圧区分に属した受診者が 120 mmHg 未満であった場合に減少可能な割合を示す。国民全てが最大血圧 120mmHg 未満となれば高血圧による脳卒中の過剰死亡率は 0%となる。

図3 最大血圧区分別の有病率と脳卒中の過剰死亡割合

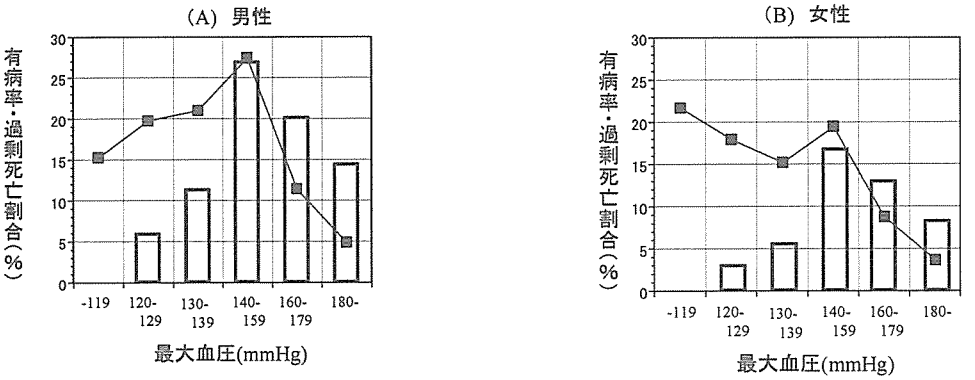


図３（A,B）に最大血圧区分別の有病率（折れ線グラフ）から過剰死亡割合（棒グラフ）を示した。図の折れ線は各区分の有病率を示す。表から明らかなように脳卒中の相対危険度は最大血圧区分が高くなるほど高まるが、最もリスクの高い区分では頻度が低いため、過剰死亡割合は少なくなった。160-169mmHg の区分では相対危険度はやや小さくなるが、有病率が高くなるため過剰死亡割合（棒グラフ）は高くなることがわかる。相対危険度はさらに低くなるが有病率が最も高い 140－159mmHg からの過剰死亡割合が最も多くなっていることが示された。1980 年の高血圧による過剰死亡は男性で８２%、女性で６３%となった。女性の方が過剰死亡が少ないのは最大血圧レベルが低いためである。もし国民がすべて最高血圧が 120mmHg 未満になったとすると、男性では 82/182 ＝45%減少可能であると考えることができる。

この考え方はさらに拡張することができる。ここでは 1980 年の循環器疾患基礎調査の結果を用いて過剰死亡を計算したが、同様の計算を 1990,2000 年の循環器疾患基礎調査結果に応用することで、各年度の最大血圧が高いことによる過剰死亡が計算できる。過剰死亡の変化と平均値の変化を対応づければ、集団の血圧変化による脳卒中死亡の変化を評価可能となる。

6. 集団の血圧平均値の変化と脳卒中死亡を関連づける

表７はその考え方に基づいて過剰死亡の変化を計算したものである。表７－１は男性の、表７－２は女性のリスクの変化を示したものである。平均的な相対危険度として複数の循環器疾患疫学研究から男性では最大血圧が 10mmHg 上昇あたり 1.2 倍、女性では 1.15 倍を用いた。男性では最大血圧 180mmHg 以上の区分では相対危険度は 4. 3 倍であり、1980 年の有病率 4.9%からに寄与危険度 3.3（=4.3-1）をかけると 16.2%となり、最大血

圧が 180mmHg 以上の最大血圧区分での過剰死亡が求められた。全ての過剰死亡を合計すると 1980 年では 81.7%となった。同様の計算を行うと 1990 年では 77.2%、1995 年では 60.7%となった。女性でも同様の計算により 47.2%から 34.6%に減少した。この成果は健康日本２１策定の根拠として用いられた。

表7-1 主要な調査結果から求めた血圧分布の実測値及び相対危険度に基づく
SBPレベル別の所見率、脳卒中の過剰死亡割合
及び低下予測%

			男性		脳卒中	SBPレベル	
			R.R.	1.2			
	-119	120-129	130-139	140-159	160-179	180-／平均血圧	
相対危険度	1.00	1.20	1.44	2.07	2.99	4.30	—
1980年循環器疾患基礎調査							
所見率	15.5%	19.8%	21.0%	27.5%	11.4%	4.9%	138.3
過剰死亡	0.0%	4.0%	9.3%	29.5%	22.7%	16.2%	81.7%
1990年循環器疾患基礎調査							
所見率	15.5%	19.5%	23.0%	27.4%	11.2%	3.5%	137.6
過剰死亡	0.0%	3.9%	10.1%	29.4%	22.2%	11.5%	77.2%
1995年国民栄養調査							
所見率	16.6%	21.6%	23.3%	33.2%	5.3%	0.0%	135.6
過剰死亡	0.0%	4.3%	10.3%	35.6%	10.5%	0.0%	60.7%

平均血圧1mmHg低下あたりの脳卒中死亡率の低下予測	男性	4.27%

表 7-2
SBPレベル別の所見率、脳卒中の過剰死亡割合

			女性		脳卒中	SBPレベル	
			R.R.	1.15			
	-119	120-129	130-139	140-159	140-169	180-／平均血圧	
相対危険度	1.00	1.15	1.32	1.75	2.31	3.06	—
1980年循環器疾患基礎調査							
所見率	25.1%	20.7%	17.5%	22.5%	10.0%	4.1%	133.9
過剰死亡	0.0%	3.1%	5.7%	16.9%	13.1%	8.4%	47.2%
1990年循環器疾患基礎調査							
所見率	24.7%	19.0%	18.6%	24.9%	9.9%	2.9%	133.7
過剰死亡	0.0%	2.9%	6.0%	18.7%	13.0%	6.0%	46.5%
1995年国民栄養調査							
所見率	32.5%	19.5%	16.8%	26.4%	4.9%	0.0%	130.0
過剰死亡	0.0%	2.9%	5.4%	19.8%	6.5%	0.0%	34.6%

平均血圧1mmHg低下あたりの脳卒中死亡率の低下予測	女性	2.19%

7. 年齢と最高血圧と最小血圧の影響

最大血圧と最小血圧の年齢による影響の違い

先の節で述べたように最大血圧であっても最小血圧であっても、循環器疾患のリスクとして有意である。しかし、年齢が少々するにつれて最大血圧は上昇するが、最小血圧はむしろ高齢者では低くなることがわかっている。表 8 には 2000 年の循環器疾患基礎調査成績から年齢階級別の最大血圧と最少血圧の平均値を男女別に示した。