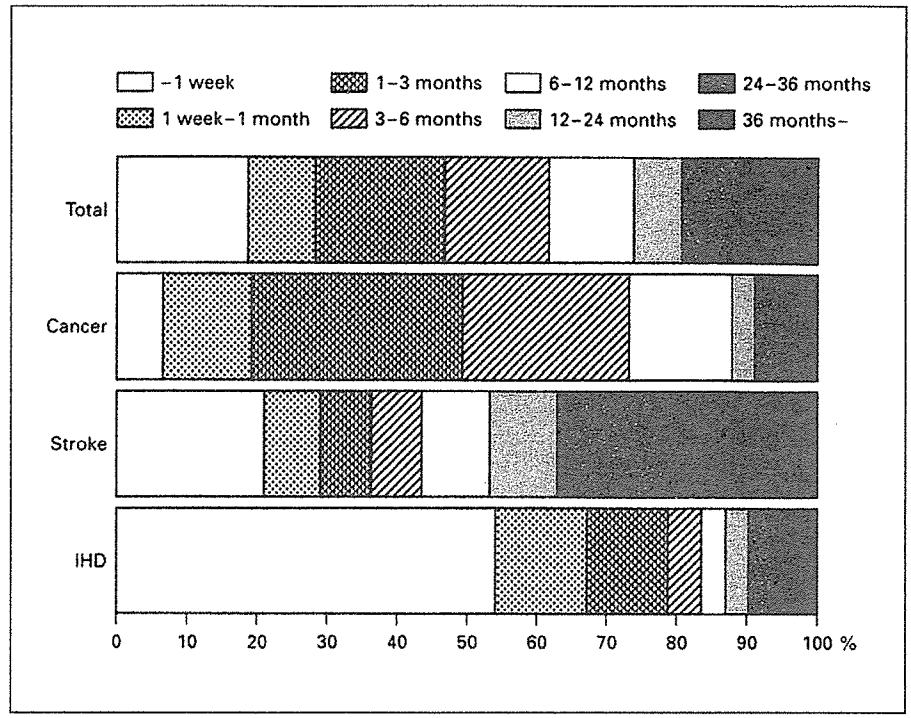

Fig. 1. Distribution of the length of life with disability before death.

those who had died aged 70–84 years, cancer accounted for 32.2% of deaths, stroke for 15.8%, and IHD for 8.5%.

Distribution of the Length of Life with Disability before Death

Among the study subjects, only 11.0% were disabled at 3 years prior to death, and 26.3% at 1 year prior to death. The frequency of disability then increased to 38.3% at 6 months, 53.1% at 3 months, 71.8% at 1 month, and 81.4% at 1 week prior to death. The frequency of disability in the subjects of this study was consistent with the Japanese national data.

The distribution of the length of life with disability before death by cause of death is shown in figure 1. The distribution varied significantly with cause of death. The median values for duration of disability were longest among those who died from stroke: the values were 3–6 months among all the deceased, less than 1 week among those who died from IHD, 3–6 months among those who died from cancer, and 6–12 months among those who died from stroke.

At 1 week prior to death, subjects who died from IHD were more active than those who died from any other causes. As many as 54.1% of those who died from IHD were independent until 1 week before death, whereas those values were only 6.6 and 21.0% in the subjects who died from cancer and stroke, respectively. Among those who died from stroke, 46.8% had been disabled for more than 12 months, whereas these values were only 13.1% among those who died from IHD and 12.2% among those who died from cancer.

Characteristics of the Deceased and Length of Life with Disability before Death

The relationships between the characteristics of the deceased and the risk of long-term disability are shown in table 1. Because disability at baseline could influence baseline behaviors, we limited this analysis to the 594 subjects who had been independent in all aspects of ADL at the time of the baseline survey. In this group, the mean age at death was 78.3 years and 377 (63.5%) were men. These lifestyle factors were assessed in 1994 and the subjects died between 1996 and 1999, so we were able to examine the relationships between lifestyle 2–5 years before death and the risk of long-term disability.

Because 6 months was the closest to the median value of the length of life with disability before death among the study subjects, we defined more than 6 months of life with disability before death as 'long-term disability'. The percentage of long-term disability varied with the cause of death: 23.5, 44.9, 8.9 and 39.4% for those who died

Table 1. Characteristics of the deceased and the risk of long-term (more than 6 months) disability before death

Characteristic		n	Long-term disability[1],%	Odds ratio[2]	95% CI	p value
Sex	Men	377	30.0	1.00	(Ref)	
	Women	217	35.5	0.83	0.50–1.39	0.48
Age at death	70–74	87	19.5	1.00	(Ref)	
	75–79	266	29.7	1.58	0.84–2.97	0.15
	80–	241	39.0	2.29	1.22–4.31	0.010
	Trend					0.0053
Cause of death	Cancer	204	23.5	1.00	(Ref)	
	Stroke	98	44.9	2.50	1.44–4.34	0.0011
	IHD	56	8.9	0.31	0.12–0.85	0.023
	Other	236	39.4	2.08	1.26–3.08	0.0028
BMI	<20.0	136	29.4	1.00	(Ref)	
	20.0–24.9	276	31.2	1.30	0.80–2.12	0.30
	≥25.0	119	40.3	2.08	1.16–3.72	0.014
	Trend					0.039
Tobacco smoking	Never smoked	197	37.1	1.00	(Ref)	
	Current smokers	167	30.5	1.06	0.60–1.85	0.85
	Past smokers	155	29.7	0.86	0.47–1.55	0.60
Walking, h/day	≥1.0	161	24.2	1.00	(Ref)	
	0.5–0.9	149	29.5	1.34	0.79–2.28	0.29
	<0.5	217	41.0	1.68	1.03–2.75	0.040
	Trend					0.028

CI = Confidence interval; IHD = ischemic heart diseases.

[1] Long-term disability denotes the period with disability before death longer than 6 months.

[2] Adjusted for sex, age at death (70–74, 75–79, and 80 years or older), cause of death, past history of hypertension, diabetes mellitus, osteoporosis and arthritis at baseline, and baseline physical functioning status (able to perform strenuous or moderate activities, able to walk one block or stairs, able to perform self-care or unable to do anything unaided).

from cancer, stroke, IHD and other causes, respectively. Compared with those who died from cancer, the odds ratio of long-term disability was 2.50 (95% CI 1.44–4.34) in those who died from stroke and 0.53 (0.12–0.85) in those who died from IHD. The odds ratio of long-term disability increased with age (p for trend = 0.053).

We examined the relationships between long-term disability before death and health-related lifestyles, including time spent walking, smoking status, and BMI. A shorter period spent walking and a higher BMI were significantly associated with risk of long-term disability before death after adjustment for sex, age at death, history of arthritis, osteoporosis, hypertension and diabetes mellitus, smoking status, physical functioning status, and cause of death. Compared with patients with BMI <20, the odds ratio of long-term disability was 1.30 (95% CI 0.80–2.12) in those with BMI 20–25 and 2.08 (1.16–3.72) in those with BMI >25 (p for trend = 0.039). The odds ratio of long-term disability significantly increased with a shorter time spent walking: compared with patients who walked >1.0 h/day, it was 1.34 (95% CI 0.79–2.28) in those who walked 0.5–0.9 h/day and 1.68 (1.03–2.75) for those who walked <0.5 h/day (p for trend = 0.028). There was no significant association between smoking history and disability. The above association was unchanged even when we changed the cut-off point for long-term disability to either 3 months or 1 year.

Because both obesity and physical inactivity are established risk factors for cardiovascular disease, the above association might be attributable to residual confounding of cardiovascular-related disability by cardiovascular risk factors. Therefore, we also examined the relationship be-

tween health-related lifestyle and the length of life with disability after stratifying by cause of death – death from cancer, IHD or stroke, and other causes. Compared with subjects with BMI <20, the odds ratio of long-term disability in those with BMI >25 were 2.88 (95% CI 1.01–8.23) for those who died from cancer, 1.54 (0.51–4.62) for those who died from IHD or stroke, and 1.50 (0.61–3.66) for those who died from other causes. Compared with those who had walked more than 1.0 h/day, the odds ratio of long-term disability among those who had walked for <0.5 h/day were 4.39 (1.57–12.29) in those who died from cancer, 2.11 (0.73–6.08) in those who died from IHD or stroke, and 0.93 (0.45–1.91) in those who died from other causes. The relationships between higher BMI and shorter time spent walking and increased risk of long-term disability before death were observed consistently across individual causes of death.

In separate models, we also examined the effect modification of the association among long-term disability before death and time spent walking, BMI, and smoking. None of the interactions tested was statistically significant (data not shown).

Discussion

Previous studies of the time-course of functional decline before death in the elderly have not identified any predictors of the length of life with disability [3, 12–14]. To clarify whether there are modifiable lifestyle factors influencing duration of disability before death, we conducted a retrospective observation of the deceased who had earlier been enrolled in a prospective cohort study. The results indicated that shorter time spent walking each day and higher BMI were significantly associated with long-term disability before death after adjustment for age at death, cause of death, and other potential confounding factors. To our knowledge, this is the first study to examine the association between a variety of lifestyle factors and duration of disability before death. Our study has some methodological strength. The subjects' lifestyles were surveyed when they lived independently and our findings were based on a prospective, population-based, representative cohort study. The follow-up rates of mortality incidence and participation of bereaved families in the study were high enough.

The characteristics of the deceased such as cause of death, age at death, and the length of life with disability were similar to the Japanese national data. The trajectory of functional disability of those who died from cancer was similar to that in the study of Lunney et al. [13], in which they reported the trajectories of functional disability for four categories (sudden death, cancer, organ failure, and frailty) using point-estimated incidence of disability before death. In our study, the time-course of disability before death varied with cause of death, and the duration of disability was greatest among those who died from stroke.

There were two potential limitations. First, information on duration of disability was obtained from proxies – a potential source of error or incorrect recollection. Second, we examined the lifestyles of subjects aged 70 years or more, but did not investigate when the subjects had started those lifestyles. Therefore, we did not determine whether the positive effect of healthy lifestyle on duration of disability before death was equally apparent in those who had recently improved their lifestyles and in those who had led healthy lives for many years.

We identified higher BMI and shorter time spent walking each day as predictors of long-term disability before death. The association between obesity and physical inactivity and disability was observed equally in each group of subjects, whether they died from cancer, stroke, IHD or other causes. This finding suggests that lifestyle factors such as BMI and daily walking may have important effects on the duration of disability, irrespective of the cause of death. There seems to be a possibility for patients to reduce their length of disability by lifestyle modification.

Although we identified only these two factors, there could be other modifiable factors for the length of disability before death. Further research is needed so that we may enhance the quality of the last months of life.

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Benefit of home blood pressure measurement after a finding of high blood pressure at a community screening

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Objective Many hypertensive individuals are not under medical management. We studied whether incorporating home blood pressure measurement and subsequent tailored advice into the primary care system improved hypertension management among untreated hypertensive individuals (screening systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥ 90 mmHg and not taking antihypertensive medication) diagnosed during a community screening.

Methods All residents aged 30 years or older in one district were asked to measure their blood pressure at home for 30 days, then received tailored advice (intervention area). Four of five Japanese districts served as a control. A self-administered questionnaire monitored the awareness and treatment of hypertension.

Results Eighty-eight per cent (106/120) of untreated hypertensive individuals in the intervention area measured home blood pressure. Of men and women meeting the criteria for untreated hypertension at a community screening in 2003, 97 intervention and 390 control individuals were rescreened in 2004. Among the untreated 2003 screening hypertensive individuals with home hypertension (home systolic blood pressure ≥ 135 mmHg or diastolic blood pressure ≥ 85 mmHg), the proportion not starting antihypertensive medication was 56%, and the proportion taking 'no action against hypertension' was 41%. These proportions were lower than in the control group (76%, 60%), yielding odds ratios (95% confidence interval) of 0.38 (0.21–0.68) and 0.42 (0.24–0.75), respectively.

Conclusion Incorporating home blood pressure measurement coupled with tailored advice into the primary care system has the potential to reduce the risk of untreated hypertension. *J Hypertens* 24:1265–1271 © 2006 Lippincott Williams & Wilkins.

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Introduction

The World Health Organization has reported that approximately two-thirds of the cerebrovascular disease burden and half of the ischemic heart disease burden are attributable to non-optimal blood pressure (BP) levels [1]. Therefore, guidelines and task forces strongly recommended population screening for hypertension [2,3]. However, the detection of high BP at screening is not a guarantee that it will be treated appropriately [4–6]. Large cross-sectional studies have determined that many hypertensive individuals are not under medical management [4–6].

Among several factors that affect compliance with hypertension therapy, several patient-related factors are well established, i.e. a lack of motivation and a lack of understanding of the risks [7]. To improve compliance and therapy, it is important to impart knowledge about the seriousness of untreated high BP and help patients recognize when they have high BP.

Self-measurement of BP at home (home BP measurements) makes it possible to obtain multiple BP measurements over a long observation period under relatively controlled conditions [8–11]. It has been reported that multiple measurements eliminate observer bias and random error; therefore home BP measurements can be more reliable than conventional BP measurements taken in medical office or screening settings [8–10,12–14]. Perhaps as a consequence of these advantages, home BP predicts cardiovascular diseases better than do conventional BP measurements [12–14]. Home BP measurements thus have the potential to improve the diagnostic classification of untreated screening hypertensive subjects.

Home BP measurement may also provide patients with an understanding of increased BP, and improve patients' hypertension control and compliance with therapy [15–18]. Therefore, we hypothesized that measuring home BP may increase hypertensive individuals' awareness of their own BP, and reduce the proportion who take no action against their hypertension.

Home BP measurement may thus play two beneficial roles: (1) to improve the diagnostic classification of untreated screening hypertensive subjects; (2) to reduce the proportion of high-risk hypertensive individuals who do not take action against hypertension, including not starting antihypertensive medication. Therefore, it is conceivable that incorporating home BP measurement together with tailored advice into the primary care system may improve hypertension management among untreated hypertensive individuals diagnosed during a community screening. To examine this hypothesis, we conducted a controlled community intervention.

Methods

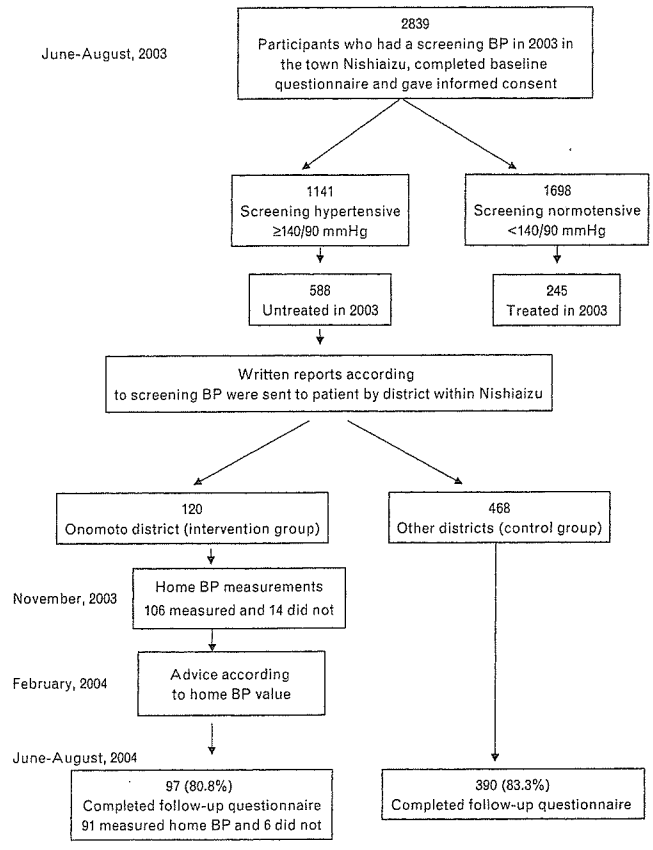
Participants

Nishiaizu is a rural town in Japan, consisting of five districts: Onomoto, Nozawa, Muraoka, Shingo, and Okugawa. Annual health check-ups (screening) including BP measurements are available once per year to all Nishiaizu residents aged 40 years or older. In June 2003, 6287 participants aged 40 years or older lived in the town. Of them, excluding the 2408 residents who would receive health check-ups at their work-site or hospital, 3879 residents were invited to have an annual check-up, and 3075 (79.3%) had a screening BP during their annual health check-up between June 2003 and August 2003 (see Fig. 1). Of them, 2975 gave informed consent for participation in this research. We excluded 136 participants who did not answer the baseline self-administered questionnaire that collected information on awareness of hypertension and its current treatment in June 2003. Among these 2839, 1141 had high screening BP, defined as systolic blood pressure (SBP) of at least 140 mmHg or diastolic blood pressure (DBP) of at least 90 mmHg (screening hypertensive). We excluded 553 of the 1141 participants because they were taking antihypertensive medication. A total of 588 screening hypertensive participants who were not taking antihypertensive medication in 2003 were included in this study (Fig. 1).

Baseline measurement

A well-trained nurse or technician, using a sphygmomanometer, measured screening BP in 2003 (baseline) and in 2004 (follow-up). All screened participants received a written report of their 2003 annual health check-up (baseline), and they were asked to modify their lifestyle (SBP/DBP 140/90–159/99 mmHg) or to consult with their physician about the results (SBP/DBP 160/100 mmHg or over). Information on age, sex, height and weight (from which we computed body mass index as kg/m^2) were also collected at the screening setting.

Fig. 1



Study design and participation in the study. Screening hypertensive: screening systolic blood pressure (SBP) at least 140 mmHg or diastolic blood pressure (DBP) at least 90 mmHg, whether treated with antihypertensive medication or not. Screening normotensive: screening SBP less than 140 mmHg and DBP less than 90 mmHg, including those whose blood pressure is controlled with medication.

Self-administered questionnaires were collected in June–August 2003 (baseline questionnaire) and at the re-screening between June and August 2004 (follow-up questionnaire). The questionnaire enquired about smoking status, drinking status and time spent walking per day. Concerning BP, the questionnaire asked 'Have you been told that you have high blood pressure?'. If 'yes', they were considered to be 'aware' of their hypertension and they were asked the following questions 'Are you taking antihypertensive medication now (yes, no)?'; 'Are you modifying your lifestyle (yes, no)?'; 'Are you watching your blood pressure level as advised by your physicians (yes, no)?' and 'Have you ever gone to a physician or done anything about hypertension (yes, no)?'.

If participants answered that they were taking antihypertensive medications, we considered them to be 'treated

hypertensives'. If not, and they were modifying their lifestyles, they were labeled 'lifestyle modifiers'. Otherwise if they answered that they were following doctors instructions to watch their BP level, we labeled them as 'monitoring BP'. Individuals who were aware of their hypertension but were not doing anything for their high BP were labeled as 'doing nothing about hypertension'. We considered untreated participants who were either 'doing nothing about hypertension' or who were 'not aware of their high BP' as 'taking no action against hypertension'.

Intervention and control group

The Onomoto district was selected for the home BP intervention. All residents of this area aged 30 years and older were asked to measure their home BP for a month (in November 2003) and were instructed to take action according to the BP level, independently of their screening BP. Among 1714 residents aged 30 years and older who were asked, 1309 (76%) measured home BP. Among study subjects who were aged 40 years and older, screening hypertensive, and not taking antihypertensive medication, 120 were asked to perform home BP measurement, 106 (88%) completed the measurement, and 91 (76%) both did so and responded to a follow-up questionnaire, whereas six responded to the questionnaire without ever performing home BP measurement (Fig. 1).

In February 2004, we held a meeting to offer advice regarding the result of home BP measurements. Representatives of households were asked to attend the meeting to receive the written home BP report and to take an instruction. Approximately half of the households attended. If they did not attend the meeting, written home BP reports with instructions were sent to each household. In the report, participants defined as 'home hypertensives' by their home BP measurements (see below) were advised to see their personal physicians, and participants defined as 'home normotensive (NT)' who nevertheless had home SBP values of 125 mmHg or greater or home DBP values of 75 mmHg or greater were instructed on how to modify their lifestyles to reduce their BP levels. Participants defined as 'home NT' who had home SBP less than 125 mmHg and home DBP less than 75 mmHg were instructed to maintain their current lifestyle. We met with each physician in Nishiaizu town and provided information on the utility of home BP measurements. However, we gave no advice about hypertension treatment to the physicians. The remaining four districts, except for Onomoto, served as the control group.

The Institutional Review Board of Tohoku University School of Medicine, Sendai, Japan, approved the study protocol.

Home blood pressure measurement

Home BP was measured using the HEM747ICN device for measurement (Omron Healthcare Co. Ltd., Kyoto, Japan), a semi-automatic device, based on the cuff-oscillometric method that generates a digital display of SBP and DBP. This device has been validated previously, and satisfies the criteria of the Association for the Advancement of Medical Instrumentation [19]. The circumference of the arm was less than 34 cm in most cases, so we used a standard arm-cuff for BP measurements. We lent one device to each household at the beginning of November 2003.

Physicians and public health nurses instructed subjects on how to perform home BP measurements following Japanese Society of Hypertension guidelines for self-monitoring BP at home [10]. In brief, subjects were asked to measure their BP every morning for 30 days during November 2003. Measurements were requested to be within 1 h of waking, before drug ingestion, after micturition, and after more than 2 min sitting rest. They were also asked to measure their BP every evening before going to bed, after 1–2 min sitting rest. Participants sent in the records to public health nurses when they returned the home BP measuring devices in December 2003.

The morning home BP of an individual was defined as the mean of all morning measurements obtained for that person; similarly for evening home BP. The mean (SD) numbers of home BP measurements were 27.8 (6.6) and 28.4 (6.0) for morning and evening, respectively. We previously observed that the average BP value obtained for the first 3 days was not significantly different from the values obtained for the entire study period [20]. We therefore treated the two participants who did not measure home BP on at least 3 days as having insufficient home BP data.

Definition of home hypertension

Based on several guidelines [8–10], subjects with home SBP of 135 mmHg or greater or home DBP of 85 mmHg or greater, regardless of whether or not they were taking antihypertensive medication, were classified as having home high BP (home hypertension; HT), whereas others were classified as having home normal (or controlled) BP (home NT). If either the morning or evening home BP indicated home HT, we categorized the participant in the home HT group.

Statistical analysis

We used *t*-tests or chi-squared tests to test the probability of a difference in baseline characteristics between the treatment and control group. We calculated the odds for not starting antihypertensive medication and the odds for 'no action against hypertension', using a multiple logistic regression model, adjusting for age, sex, body mass index, smoking status, drinking status and time spent walking per day. We treated $P < 0.05$ as statistically significant.

Results

In this population, 1386 participants were classified as hypertensive (1141 screening hypertension and 245 screening normotensive with antihypertensive medication; Fig. 1). Approximately half (798/1386, 57.8%) of hypertensive individuals were taking antihypertensive medication.

Among 588 participants (aged 40–94 years) who had high screening BP measured in June–August 2003, who were not taking antihypertensive medication, and who then completed the questionnaire, 487 were reassessed at the screening office in June–August 2004 (follow-up rate 82.8%). No difference was observed in the follow-up rate between the intervention and control groups (Fig. 1). The percentage of participants who walked less than 1 h/day was lower in participants who did not complete follow-up (53.0%) than in those who completed (66.8%). Otherwise, no significant differences were observed between participants who completed follow-up and participants who did not (data not shown). Table 1 shows baseline characteristics, hypertension awareness and treatment status in 2003. The 2003 screening SBP was lower in the intervention group than in the control group. Percentages of current drinkers were higher in the intervention group than the control group. No other baseline differences were observed between the intervention and control groups. The 2003 screening SBP/DBP was not significantly different between the home HT group (146.9/85.3 mmHg) and the home NT group (145.3/84.8 mmHg). Table 2 shows the high BP awareness and treatment status in 2004 for the untreated screening HT in 2003. The intervention group had a higher rate of initiating antihypertensive medication (30.9%) compared with the control group (23.9%). Some 60.3% of the control group did not take any action against hypertension (9.0% were 'doing nothing about hypertension' and 51.3% claimed to be unaware). After stratification of the intervention group according to home BP status, compared with the control group home HT participants had a higher rate of starting to take antihypertensive medication (44.1%) and a lower percentage who took no action against hypertension (40.7%). Similarly, the home NT group had lower rates of action than the control group: 9.4% starting antihypertensive medication, and 84.4% taking no action against hypertension.

Table 3 shows the odds ratio for intervention versus the control group of not taking antihypertensive medication or of not taking action in 2004 among those who were untreated in 2003. Compared with the control group, the odds ratio for not starting antihypertensive medication was significantly lower in the home HT group [odds ratio (OR) 0.38, 95% confidence interval (CI) 0.21–0.68] and higher in the home NT group (OR 3.08, 95% CI 0.90–10.58). Similarly, the odds ratio for no action against hypertension was lower in the home HT group (OR 0.42, 95% CI 0.24–0.75) and higher in the home NT group (OR 3.30, 95% CI 1.23–8.86) compared with controls.

We also analysed the subgroup of participants whose screening BP was SBP 160 mmHg or greater and DBP 100 mmHg or greater at baseline, similar tendencies were observed, although their numbers were few. The

Table 1 Baseline characteristics of screening hypertensive individuals not taking antihypertensive medication, June–August 2003. Nishiaizu, Japan

	All participants			Participants who completed follow-up		
	Control	Intervention	*P* value	Control	Intervention	*P* value
n	468	120		390	97	
Age (years)	67.2	67.5	0.77	66.9	68.1	0.27
Women (%)	56.0	53.3	0.60	57.2	51.6	0.32
Body mass index (kg/m^2)	23.6	23.5	0.83	23.7	23.4	0.40
Screening SBP (mmHg)	149.8	146.7	< 0.01	149.7	146.6	< 0.01
Screening DBP (mmHg)	86.7	85.5	0.13	86.6	85.2	0.09
Smoking status (%)						
Current	19.0	14.6		17.4	13.2	
Former	22.9	28.1		23.9	32.9	
Never	58.1	57.3	0.42	58.7	54.0	0.24
Drinking status (%)						
Current	50.8	64.2		50.6	63.6	
Former	5.6	3.7		5.4	3.4	
Never	43.6	32.1	0.04	44.0	33.0	0.09
Time spent walking per day (%)						
Less than 0.5 h	64.0	66.1		66.4	68.4	
0.5–1 h	23.3	19.5		22.2	16.8	
1 h+	12.8	14.4	0.65	11.4	14.7	0.41
Awareness and action for hypertension in 2003						
Aware of hypertension[a]						
Modifying lifestyle	16.0	15.8		16.4	17.5	
Monitoring BP	12.2	11.7		11.8	13.4	
Doing nothing about hypertension	10.5	7.5		10.8	8.3	
Not aware of hypertension	61.3	65.0	0.78	61.0	60.8	0.87

BP, Blood pressure; DBP, diastolic blood pressure; SBP, systolic blood pressure. [a]Actions taken in those aware of hypertension are in hierarchical order.

Table 2 **Awareness and action concerning hypertension at follow-up in 2004, according to 2003 condition**

Status in 2004	Control group	Intervention group			
	All	All	Home HT	Home NT	No home BP
No. of participants	390	97	59	32	6
Aware of hypertension[a]					
Treated hypertensives (%)	23.9	30.9	44.1	9.4	16.7
Modifying lifestyle (%)	10.8	9.3	11.9	6.3	0.0
Monitoring BP (%)	5.1	2.1	3.4	0.0	0.0
Doing nothing about hypertension (%)	9.0	16.5	15.3	15.6	33.3
Not aware of hypertension (%)	51.3	41.2	25.4	68.8	50.0

BP, Blood pressure; HT, hypertension; NT, normotension; Home HT, home systolic BP at least 135 mmHg or home diastolic BP at least 85 mmHg; Home NT, home systolic BP lower than 135 mmHg and home diastolic BP lower than 85 mmHg; No Home BP, participants who did not measure home BP. [a]Actions taken in those aware of hypertension are in hierarchical order.

percentage of participants who initiated taking antihypertensive medication was higher in the home HT group (4/9, 44.4%) and lower in the home NT group (1/3, 33.3%) compared with the control group (29/82, 35.4%). Similarly, the percentage taking no action against hypertension was lower in the home HT group (2/9, 22.2%) and higher in the home NT group (2/3, 66.7%) compared with the control group (37/82, 45.1%).

We assessed the follow-up screening BP level among the three groups, i.e. home HT group, home NT group, and control group. Follow-up screening BP was the highest in the control group (SBP/DBP 141.9/81.2 mmHg), followed by the home HT group (141.1/81.0 mmHg) and the home NT group (135.4/76.5 mmHg). The percentages of screening high BP in 2004 was higher in the control group (57.7%) compared with the intervention group (combined home HT, home NT, and no home BP group; 46.4%) ($P = 0.045$ by chi-squared test).

Discussion

In this clinical trial, we examined the effect on untreated hypertension management of incorporating home BP measurements followed by tailored advice into the primary care system for hypertension. Among untreated screening hypertensive individuals in 2003 in the present study, 76% of the control group were not taking antihypertensive medication 1 year later, and 60% of them had not taken any action against hypertension by 2004. However, in the corresponding untreated screening hypertensive individuals, the combination of home BP measurement for a month and tailored referral advice reduced the percentage not taking antihypertensive medication or not taking action in the home HT group. Therefore, as hypothesized, home BP monitoring identified those who did need treatment and improved the proportion of participants with antihypertensive treatment.

A recent report, based on the National Health and Nutrition Examination Survey (NHANES III) studies in the United States and the Canadian Heart Health Surveys (CHHS), showed that many north American adults were unaware of their hypertension (30% for NHANES III; 43% for CHHS) or aware of their hypertension but not treated (18% for NHANES III; 22% for CHHS) [4]. Therefore, 48 and 65% of hypertensive individuals were not treated for their BP in the USA and Canada, respectively. Furthermore, this rate was rather higher in European populations; only 26.8% for the pooled population were treated (range 24.8–32.0%)

Table 3 **Risk of not taking antihypertensive medication or of no action for hypertension in 2004 among untreated screening hypertensives in 2003**

Not taking antihypertensive medication in 2004					
	n	Untreated in 2004	%	OR	95% CI
Control group	390	297	76%	1	
Intervention group					
HHT	59	33	56%	0.38	0.21–0.68
HNT	32	29	91%	3.08	0.90–10.58
No action for hypertension in 2004					
	n	No action for hypertension through 2004	%	OR	95% CI
Control group	390	235	60%	1	
Intervention group					
HHT	59	24	41%	0.42	0.24–0.75
HNT	32	27	84%	3.30	1.23–8.86

CI, Confidence interval; OR, odds ratio; HHT, Home hypertensive, home systolic blood pressure of 135 mmHg or greater and home diastolic blood pressure of 85 mmHg or greater; HNT, home normotensive, home systolic blood pressure less than 135 mmHg and home diastolic blood pressure less than 85 mmHg. No action for hypertension, Doing nothing about hypertension (including untreated) plus not aware of hypertension.

[6]. Our study also showed that 43% (588 of 1386 hypertensive individuals) were untreated. The problem that many hypertensive individuals are not under medical management is thus a worldwide issue.

Twenty-four per cent of the control group initiated antihypertensive medication and 40% of them took some action against hypertension by 2004. Although we have no specific information about why so many of the screening participants took no action, it may be that they believed that high BP in screening is only a result of nervousness or related white-coat effects. Whatever the reason, this tendency towards inaction applied even to those participants whose untreated screening BP was SBP 160 mmHg or greater and DBP 100 mmHg or greater, even though they were immediately referred to see their physician. Only 35.4% of the 82 participants in this category in the control group initiated antihypertensive medication and 45.1% did not take any action against their hypertension. This finding might support the findings that the detection of high BP at screening solely is not a guarantee that it will be treated appropriately [4–6].

However, compared with the control group, the home HT group showed a lower proportion of participants who did not start medication or those who did not take any action against hypertension. As home HT participants had a higher cardiovascular disease risk than home NT participants [12–14], these participants did need antihypertensive medication. Therefore, incorporating home BP measurement followed by tailored advice into the primary care system reduced the risk of untreated hypertension and the risk of taking no action against hypertension in home HT participants.

On the other hand, the home NT group showed a rather lower proportion of participants who started medication. This might be because we defined their home BP as lower than the well-accepted home hypertension criteria by general guidelines. A recent study reported that the risk of cardiovascular events for white-coat hypertensive individuals, namely elevated BP in the office but not at home, did not differ from the risk in controlled hypertension, namely in those whose home and office BP were both controlled [13]. Therefore, individuals who do not have high home BP have less need for antihypertensive treatment than those who have high home BP. The overtreatment of BP can cause adverse effects, and may incur unnecessary costs [21]. Furthermore, the follow-up screening BP level was the lowest in the home NT group among the three groups, namely home NT, home HT, and the control group. Although the home NT group instruction led to less intense treatment, and they actually had less treatment, their follow-up BP level was relatively low, maybe because of their lower 'true BP level'. Therefore, this finding that the home NT group had lower rates of starting antihypertensive medication could be considered as an additional beneficial effect of home BP measurements after community screening. However, we draw this conclusion cautiously because the prognostic implications of white-coat hypertension are still debated [22]. A long-term study of BP and disease outcomes in a large group of home normotensive individuals would be desirable.

Among untreated hypertensives in the intervention area, 88% (106/120) measured home BP for at least 3 days. Therefore, using home BP measurement after mass BP screening is feasible. The feasibility may have been enhanced in the setting of this study, given the wide use of the home BP measurement device in Japan [9]. Further study would help to clarify the feasibility of home BP measurement in other primary care settings.

We have some methodological limitations in this paper. This study was not an individual randomized trial, with the result that some baseline characteristics were different between the control and intervention group. However, the treatment was realistic as we asked all residents aged 30 years or older in the intervention area to measure home BP and achieved a high response rate; the potential of self-selection bias is low. Another potential bias arises because home BP measurement devices are already in wide use in Japan [10], so a certain proportion of the control group might have measured their home BP. This would have caused an underestimate of the benefit of home BP measurement. Another possible bias is that we had only one measurement of screening BP, given Japanese rules for screening. Therefore, the initial BP status might be misclassified. A caveat is that participants in the home NT group were more likely to answer that they did not have hypertension in 2004. Although these participants might have altered their lifestyle (we did not ask about this in individuals who said they did not have hypertension), home monitoring could conceivably cause these individuals to underestimate their future risk of hypertension. We acknowledge that a periodic check-up on the participants to ensure they were using the correct home BP measurement technique should increase the reliability of participants' home BP report. However, as we asked all residents aged 30 years or over in the Onomoto district to measure home BP for 1 month (November 2003) [of 1714 residents aged $\geq$ 30 years who were asked, 1309 (76%) measured home BP], we had insufficient staff for this quality enhancement effort. Nevertheless, the procedure we used was a realistic model of how home BP measurement might be used in general practice. Finally, as we did not ask participants to measure follow-up home BP, we could not provide information on the degree of BP control assessed by home BP, which would not be biased by a white-coat effect. Nevertheless, the screening BP measurement that we carried out is highly relevant.

In conclusion, we found that incorporating home BP measurement followed by tailored advice into the primary care system reduced the risk of untreated hypertension and the risk of taking no action against hypertension in the home BP monitoring group with a high home BP value. Incorporating home BP monitoring with subsequent tailored advice into general practice could lead to a lower incidence of cardiovascular disease complications.

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レセプト全傷病登録による糖尿病の合併症の医療費分析

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目的　近年，糖尿病患者の医療費が増加しているなか，糖尿病の合併症が医療費に及ぼす影響を定量的に検証することは，医療費を適正化するための対策を検討する上で重要である。これまでの国内における糖尿病の合併症の医療費分析は少数の施設に限定され，地域住民を対象にしたものはなかった。また，従来の診療報酬明細書により把握できる傷病は主傷病のみであったため，合併症の正確な把握は困難であり，医療費に及ぼす影響も十分に把握できなかった。この問題点を打開し，糖尿病とその合併症の保有状況を把握し，医療費構造を明らかにするには，主傷病だけではなくすべての傷病を診療報酬明細書に記載することが望まれる。本研究の目的は，地域住民を対象に，全傷病登録による国民健康保険診療報酬明細書を用いて，糖尿病の合併症が医療費に及ぼす影響を分析することである。

方法　調査対象は宮城県内7町における国民健康保険加入者全員の中から平成14年5月1日から31日までの間に医療機関を受診した17,994人のうち，糖尿病または糖尿病性傷病名が診療報酬明細書に記載されている2,999人である。診療報酬明細書により性，年齢，傷病名，受療状況（入院・外来の各日数）と入院・外来・調剤の各費用を把握し，糖尿病の合併症を有しない群と，有する群の1人当たり1か月医療費を，性，年齢を補正した共分散分析により比較した。続いて，性，年齢に加えて，それぞれの合併症の有無を補正し比較を行った。

結果　糖尿病患者全体において，性，年齢，それぞれの合併症を補正し，合併症を有しない群と有する群で1人当たり1か月医療費を比較すると，腎症（55,421円，1.71倍），網膜症（44,265円，1.65倍），脳血管障害（22,296円，1.33倍），心疾患（51,726円，1.88倍）では合併症を有する群で有意に高かった。一方，神経障害（8,771円，0.88倍）では有意差を認めなかった。糖尿病患者の1か月医療費総額において，腎症は7.1%，網膜症は4.9%，脳血管障害は5.5%，心疾患は17.7%を占めていた。

結論　糖尿病の合併症のなかで，医療費に影響を及ぼしたのは糖尿病性腎症，糖尿病性網膜症，脳血管障害，心疾患であった。これらの合併症を予防することで，糖尿病医療費の顕著な低下を期待されることが示唆された。

Key words：全傷病登録，国民健康保険診療報酬明細書，医療費，糖尿病，合併症

I　緒　　言

近年，糖尿病の有病率は世界的に増加しており，今後も増加することが予想されている[1~3]。糖尿病患者の増加は医療費の増加につながり，医療経済の上で大きな問題である[4~7]。日本においても，糖尿病患者数は，人口の高齢化，生活習慣や社会環境の変化に伴い急速に増加している。厚生労働省平成14年度「糖尿病実態調査」[8]によると，糖尿病が強く疑われる者は約740万人，糖尿病の可能性を否定できない者を合わせると約1,620万人と推計され，国民全体の約8人に1人に相当する。このことは同時に医療費にも大きな影響を及ぼすものであり，厚生労働省平成13年度「国民医療費」[9]によると，同年の医療費総額31.3兆円のうち，1兆1743億円に及ぶと推定されてい

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る。また，糖尿病は長期にわたる様々な大血管障害，微小血管障害の合併症を引き起こす。糖尿病の合併症が医療費に及ぼす影響を定量的に検証することは，医療費を適正化するための対策を検討する上で重要な意味を有する。

糖尿病の合併症の医療費を分析した先行研究は，糖尿病の医療費の将来推計を行った研究[10,11]と，一時点における糖尿病医療費の合併症の割合を検討した研究に分類される[12~25]。後者はさらに，具体的な患者集団の医療費をもとに国の糖尿病医療費を推計した研究[12~16]と，特定の患者集団の糖尿病医療費を実測した研究[17~25]に細分化される。これら先行研究の多数において，糖尿病患者における合計医療費のうち循環器疾患[10~13,15,18,22,24,26]や腎症[10,11,18,22,24]の占める割合が大きいことが報告されている。

日本国内の先行研究はこれまで3件報告されており[25~27]，いずれも特定の患者集団の医療費を実測したものである。第一に柿原は，10病院に外来通院する2型糖尿病患者120人を対象に調査を行った[25]。その際に12か月間の診療報酬明細書に基づき医療費を算出した。その結果，1人当たりの1か月医療費が虚血性心疾患を有すると5,952円，腎症を有すると2,755円，網膜症を有すると2,790円，神経障害を有すると19,406円高くなると報告している。第二に柿原らは，1医療機関に外来通院する1型糖尿病患者33人，2型糖尿病患者180人を対象に調査を行った[26]。その際に1年間の診療報酬明細書に基づき医療費を算出し，診療録に基づき合併症を把握した。その結果，糖尿病科に通院する2型糖尿病患者の1人当たり医療費が循環器疾患を有すると12,007円，腎症を有すると2,702円，網膜症を有すると8,236円，神経障害を有すると22,867円高くなり，糖尿病科以外の他科に通院する2型糖尿病患者の1人当たり医療費が循環器疾患を有すると15,424円，腎症を有すると794円，網膜症を有すると3,433円，神経障害を有すると22,656円，高くなると報告している。第三に内潟らは糖尿病特殊外来のない1医療機関に外来通院する糖尿病患者81人を対象に調査を行った[27]。その際に，11か月間の診療報酬明細書に基づき医療費を算出し，主治医が記入した調査表に基づき合併症を把握した。その結果，医療費が腎症を有する者は有しない者に比し2.1倍，網膜症を有する者は有しない者に比し2.6倍，神経障害を有する者は有しない者に比し3.3倍高くなることが報告されている。

しかし，これら日本国内の研究は，1つまたは少数の医療施設の外来患者に限定されている。また，2つの研究において腎症の医療費は高かったが，他の合併症に比べ増加額が低く[25,26]有意な関連がみられなかった[25]。これは透析患者が除外され[25]，末期腎不全が除外されている[26]ためと考えられる。

糖尿病の合併症が医療費に与える影響をより正確に検証するためには，対象者を特定の医療機関に限定せずに，地域住民全体を対象に医療機関を受診した糖尿病患者すべてを把握することが望ましい。その際の方法として，診療報酬明細書を用いることが考えられるが，従来の診療報酬明細書により把握できる傷病は主傷病のみであったので，合併症の正確な把握は困難であった。また，脳血管障害，心疾患，腎不全は，主傷病として記載される場合が多い[28]。とりわけ，糖尿病患者が，これらの傷病を有していれば，主傷病登録では糖尿病の傷病名が記載されないため，合併症として脳血管障害，心疾患，腎不全を把握することが困難であった。このような問題点を解決するための一方法として，診療報酬明細書の傷病名欄には，主傷病だけではなくすべての傷病を記載することが考えられる。

宮城県国民健康保険団体連合会は，このようなすべての傷病（診療報酬明細書1件につき最大15傷病まで）を記載するシステムを平成7年度より「レセプト全疾病分析システム」として使用している。また，狭心症，急性心筋梗塞，心筋梗塞，糖尿病性腎症，糖尿病性網膜症，糖尿病性神経障害などの44傷病を追加している。このシステムにより，従来の傷病分類では困難であった糖尿病とその合併症の保有状況を正確に把握し，医療費の評価をすることができる。そのため本研究は，地域住民を対象とし，糖尿病の合併症が医療費に与える影響を定量的に解明するために，このシステムを用いて分析を行った。

そのことを通して，糖尿病の合併症を予防するための保健医療ケアの医療費に及ぼす影響を定量的に解明され，予防サービスの経済的価値を示すことになる。

本研究の目的は，宮城県内の7町に居住する国民健康保険加入者全員を対象に，「レセプト全疾病分析システム」を用い，第1に地域における糖尿病の受療実態を明らかにし，診療報酬明細書の全傷病登録と主傷病登録との相違を検証すること，第2に糖尿病の合併症である腎症，網膜症，神経障害，脳血管障害，心疾患が医療費に与える影響を明らかにすることである。

Ⅱ　研究方法

1.　全傷病登録による診療報酬明細書の概要

宮城県国民健康保険団体連合会の構築した「レセプト全疾病分析システム」は，平成7年度より県内の一部市町村を対象に，ある月の診療分すべての診療報酬明細書について，記載されている全傷病名をコード入力したデータベースである。

傷病名のコード入力では，診療報酬明細書1件に記載されているすべての傷病(最大15傷病まで)が登録された。傷病の登録にあたっては平成7年1月1日の社会保険表章疾病分類表の中分類[29]119分類の傷病を用いた。くわえて，一部の傷病については宮城県国民健康保険団体連合会が独自に細分化した44傷病を追加している（表1)。そして宮城県国民健康保険団体連合会が被保険者情報，給付情報，保険医療機関情報の電算共同処理データと連結してデータベースを構築している。

2.　個人情報保護および倫理上の配慮

本研究は宮城県国民健康保険団体連合会から東北大学大学院医学系研究科公衆衛生学分野への委託により行われている。国民健康保険診療報酬明細書・データ提供にあたって，被保険者の個人情報保護および倫理上の観点から以下の措置が取られた。

第1に国民健康保険診療報酬明細書・データの提供に関する同意を当該の国民健康保険者すなわち地方公共団体の首長から書面により得ている。

第2に国民健康保険診療報酬明細書・データは患者の個人情報を持つため，文部科学省・厚生労働省「疫学研究に関する倫理指針」（平成14年7月1日施行)，および個人情報の保護に関する法律(平成15年5月30日法律第57号)の趣旨に沿い，宮城県国民健康保険団体連合会と東北大学大学院

表1　宮城県国民保険団体連合会による追加コードと傷病名

追加コード	傷病名	追加コード	傷病名
201	高脂血症	223	脂肪肝
202	高血圧症	224	腰痛症
203	アトピー性皮膚炎	225	B型肝炎
204	膝関節症	226	子宮頚部がん
205	糖尿病	227	子宮体がん
206	糖尿病性高血圧	228	前立腺がん
207	糖尿病性腎症	229	インスリン依存性糖尿病
208	糖尿病性神経障害	230	アレルギー性結膜炎
209	糖尿病性白内障	231	本態性高血圧
210	糖尿病性網膜症	232	狭心症
211	高血圧性腎症	233	急性心筋梗塞
212	動脈硬化性痴呆	234	頚動脈硬化
213	片麻痺	235	食道静脈瘤
214	C型肝炎	236	インフルエンザ
215	肝癌	237	痛風
216	インスリン非依存性糖尿病	238	変形性脊椎症 or 変形性腰椎症
217	肥満症	239	妊娠中の糖尿病
218	慘出性中耳炎	240	大腿骨頸部骨折
219	筋萎縮性側索硬化症	241	大腿骨骨折
220	脊髄小脳変性症	242	心房細動
221	骨粗鬆症	243	心筋梗塞
222	末梢神経傷害	244	高尿酸血症

医学系研究科公衆衛生学分野との間で「国民健康保険診療情報提供業務委託契約」を書面により締結した。そこにおいては，個人の特定ができないようにするために，宮城県国民健康保険団体連合会が対象者の氏名，生年月日，国民健康保険番号の基番，員番を削除（連結不可能匿名化）したうえで，データを東北大学大学院医学系研究科公衆衛生学分野に提供することとした。さらに提供情報の取扱，保管にあたって情報処理に関わる実務担当者の制限，情報の施錠保管など厳格な管理の下に適正に扱い，提供された情報の目的外利用の禁止を取り決め，研究対象者に危険や不利益が生じる可能性がないようにした。なお本研究は東北大学医学部・医学系研究科倫理委員会の承認を得ている。

3. 対象

「レセプト全疾病分析システム」を実施している宮城県内の7町において，平成14年5月時点の国民健康保険加入者は全員で31,023人である。このうち平成14年5月1日から31日までの期間に診療を受けた（診療報酬明細書がある）者は17,994人であった。そのうち社会保険表章疾病分類表の中分類（平成7年1月1日）による糖尿病と宮城県国民健康保険団体連合会が独自に追加した44疾病による糖尿病，糖尿病性高血圧，糖尿病性腎症，糖尿病性神経障害，糖尿病性白内障，糖尿病性網膜症，インスリン非依存性糖尿病，インスリン依存性糖尿病，妊娠糖尿病のいずれかの傷病名が国民健康保険診療報酬明細書に記載されていた2,999人（男性1,455人，女性1,544人）を研究対象とした。

平成14年5月診療分の国民健康保険診療報酬明細書から性，年齢（宮城県国民健康保険団体連合会が，国民健康保険加入者の平成14年5月1日時点の年齢を別途記載したもの），傷病名，入院・外来・調剤の日（回）数と，それぞれの費用を把握した。糖尿病の判定は，宮城県国民健康保険団体連合会の追加コードによる糖尿病性腎症，糖尿病性神経障害に加えて，上記の糖尿病および糖尿病関連疾患を有している者で診療報酬明細書に社会保険表章疾病分類表の中分類による腎不全とある者は糖尿病性腎症として分類した。同様に宮城県国民健康保険団体連合会の追加コードによる末梢神経障害とある者は糖尿病性神経障害を合併している者として分類した。また本研究においては，診療報酬明細書の傷病名の欄に「疑い」を含む病名があった場合は，登録に含めていない。

4. 解析方法

第1に，糖尿病および糖尿病関連疾患の傷病名が記載されていた2,999人を対象として，全傷病登録と主傷病登録との間での患者数と1人当たり医療費を比較した。

第2に，糖尿病の合併症である腎症，網膜症，神経障害，脳血管障害，心疾患が医療費に及ぼす影響を共分散分析により解析した。また，入院と外来に分けた解析も行った。それぞれの合併症の有無を説明変数，1人当たり1か月の平均医療費を目的変数とした。

解析にあたり性別と年齢を補正したモデルと，さらに性別，年齢，5つの合併症を相互に補正した多変量モデルの2種類を検討した。多変量補正では，腎症の合併症を有する群と有しない群で1人当たり1か月平均医療費を比較する場合は，腎症を共変量から除き，性，年齢と他の合併症である神経障害，網膜症，脳血管障害，心疾患は有する場合に1，有しない場合に0とするダミー変数を説明変数とする共分散分析を行った。同様の方法で，他の合併症についても，その合併症を有する群と有しない群の比較を行う場合には当該合併症を共変量から除き，それ以外の合併症を説明変数に組み込んだ。解析は統計パッケージSAS. Version8.2（SAS Inc, Cary NC）のANCOVAプロシジャを用いた。

Ⅲ 研究結果

糖尿病における診療報酬明細書記載の全傷病登録と主傷病登録の比較を表2に示す。全傷病登録で糖尿病の記載のあった2,999人のうち，糖尿病が主傷病とされた者は1,198人に過ぎず，従来の

表2　糖尿病の全傷病登録と主傷病登録の比較

	人数（人）	1人当たり平均医療費（円）（標準偏差）
全傷病登録	2,999	71,375（181,966）
主傷病登録	1,198	63,106（199,661）
比率*	0.40	0.88

* 主病登録/全傷病登録

主傷病登録は全傷病登録の4割の糖尿病患者を把握しているに止まった。また1人当たり1か月平均医療費では全傷病登録では71,375円，主傷病登録では63,106円であった。

10歳階級別に，糖尿病における診療報酬明細書記載の全傷病登録と主傷病登録の比較を表3に示す。年齢層が高くなるにつれ，全傷病登録に対し主傷病登録は，糖尿病患者数を把握する比率が少なくなる傾向がみられた。

2,999人の性別と年齢階級を表4に示す。男性は1,455人，女性は1,544人であった。平均年齢は69.7歳（男性67.9歳，女性71.4歳）であった。男女ともに70歳から79歳までの年齢層が最も多く（男性35.8%，女性42.0%），次いで60歳から69歳の年齢層（男性34.6%，女性26.7%），80歳以上の年齢層（男性11.8%，女性19.9%）であった。

糖尿病患者の合併症の保有状況を表5に示す。腎症は全体の9.1%でみられ（男性：9.7%，女性：8.5%），その割合は80歳以上が最も大きかった。網膜症は全体の8.0%でみられた（男性：7.3%，女性：8.6%）。年齢との一定の関連を示さなかった。神経障害は全体の9.9%で見られ（男性：9.1%，女性：10.6%）でみられ，高齢になるほど割合が大きかった。脳血障害は全体の17.7%で見られ（男性：18.1%，女性：17.4%），高齢になるほど割合が大きかった。心疾患は全体の24.5%でみられ（男性：22.6%，女性：26.2%），高齢になるほど割合が大きかった

糖尿病の合併症である腎症，網膜症，神経障害の組み合わせの状況を表6に示す。糖尿病患者のなかで合併症を有していない者は男性が760人（52.2%），女性が767人（49.7%）であった。糖尿病患者全体において，糖尿病患者において合併症を1つだけ有している1群合併では心疾患が男女ともに高い割合を示した（男性：12.6%，女性：14.7%）。合併症を2つ有している2群合併では脳血管障害と心疾患の合併が男女ともに高い割合を示した（男性：4.2%，女性：4.9%）。合併症を3つ有している3群合併は腎症，脳血管障害，そして心疾患の合併が男女ともに高い割合を示した（男性：0.9%，女性：0.6%）。合併症を4つ有している4群合併では，男女で0.1%から0.3%の割合であった。そして，腎症，神経障害，網膜症，脳血管障害，心疾患をすべて有していた男性は1人（0.1%），女性は1人（0.1%）であった。

糖尿病の合併症が1か月当たりの医療費に与える影響を，共分散分析により解析した結果を表7に示す。まず，性・年齢を共変量とし，糖尿病の

表4　対象者の基本特性（人）

年齢	男性（%）	女性（%）	総数（%）
≦59	258(17.7)	177(11.5)	435(14.5)
60-69	504(34.6)	412(26.7)	916(30.5)
70-79	521(35.8)	648(42.0)	1,169(39.0)
80≦	172(11.8)	307(19.9)	479(16.0)
総数	1,455	1,544	2,999

表3　年齢階級別全傷病登録と主病登録の糖尿病患者の比較

年　齢	人　数　（人）			1人当たり平均医療費（円）（標準偏差）		
	全傷病登録	主傷病登録	比　率*	全傷病登録	主傷病登録	比　率*
0- 9歳	0	0	—	—	—	—
10-19歳	2	1	0.50	45,000(4,851)	48,430 —	1.08
20-29歳	9	4	0.44	60,611(87,161)	35,200(16,619)	0.58
30-39歳	21	11	0.52	58,655(107,267)	33,133(13,272)	0.56
40-49歳	83	43	0.52	71,525(136,662)	54,871(111,147)	0.77
50-59歳	320	142	0.44	57,727(115,958)	52,846(96,413)	0.92
60-69歳	916	388	0.42	50,446(103,138)	46,141(76,775)	0.91
70-79歳	1,169	454	0.39	84,270(284,661)	80,466(271,952)	0.95
80-89歳	423	137	0.32	85,638(167,650)	68,676(102,419)	0.80
90歳以上	56	18	0.32	122,007(283,900)	74,502(134,070)	0.61

* 主病登録/全傷病登録

表5　糖尿病患者の合併症の保有状況

年齢	対象者数	腎症（%）	網膜症（%）	神経障害（%）	脳血管障害*(%)	心疾患**(%)
男性						
≦59	258	28(10.9)	28(10.9)	18(7.0)	15(5.8)	22(8.5)
60-69	504	39(7.7)	33(6.5)	45(8.9)	83(16.5)	91(18.1)
70-79	521	51(9.8)	33(6.3)	51(9.8)	117(22.5)	146(28.0)
80≦	172	23(13.4)	12(7.0)	19(11.0)	48(27.9)	70(40.7)
合計	1,455	141(9.7)	106(7.3)	133(9.1)	263(18.1)	329(22.6)
女性						
≦59	177	15(8.5)	12(6.8)	12(6.8)	7(4.0)	21(11.9)
60-69	412	32(7.8)	37(9.0)	41(10.0)	47(11.4)	82(19.9)
70-79	648	53(8.2)	66(10.2)	76(11.7)	122(18.8)	188(29.0)
80≦	307	32(10.4)	18(5.9)	34(11.1)	93(30.3)	114(37.0)
合計	1,544	132(8.5)	133(8.6)	163(10.6)	269(17.4)	405(26.2)
総計	2,999	273(9.1)	239(8.0)	273(9.9)	273(17.7)	273(24.5)

* 脳血管障害は脳内出血，脳梗塞を含む
** 心疾患は虚血性心疾患，狭心症，急性心筋梗塞，心筋梗塞を含む

合併症それぞれについて，合併症を有しない群と有する群の1か月当たり調整平均医療費の分析を行った。その結果，腎症の非合併群は66,010円，合併群では124,946円であり，腎症の合併群は非合併群に比べて58,935円の有意な医療費の増加がみられた（P値＜0.001）。網膜症の非合併群は67,356円，合併群では117,793円であり，網膜症の合併群は非合併群に比べて50,437円の有意な医療費の増加がみられた（P値＜0.001）。神経障害の非合併群は71,047円，合併群では74,369円であり，神経障害の合併群は非合併群に比べて3,322円の医療費増加がみられたが，有意ではなかった（P値＝0.79）。脳血管障害の非合併群は66,123円，合併群では95,733円であり，脳血管障害の合併群は非合併群に比べて29,610円の有意な医療費の増加がみられた（P値＝0.002）。心疾患の非合併群は57,889円，合併群では112,992円であり，心疾患の合併群は55,103円の有意な医療費の増加がみられた（P値＜0.001）。

つぎに，性・年齢に加えて腎症，網膜症，神経障害の合併症を同時に共変量として投入した共分散分析を行った。その結果，腎症の非合併群は67,004円，合併群では114,623円であり，腎症の合併群は非合併群に比べて55,421円の有意な医療費の増加がみられた（P値＜0.001）。網膜症の非合併群は67,848円，合併群では112,113円であり，網膜症の合併群は非合併群に比べて44,265円の有意な医療費の増加がみられた（P値＝0.001）。神経障害の非合併群は72,241円，合併群では63,470円であり，神経障害の合併群は非合併群に比べて8,771円の医療費低下がみられたが，有意ではなかった（P値＝0.47）。脳血管障害の非合併群は67,346円，合併群では89,642円であり，脳血管障害の合併群は非合併群に比べて22,296円の有意な医療費の増加がみられた（P値＝0.02）。心疾患の非合併群は58,715円，合併群では110,441円であり，心疾患の合併群は51,726円の有意な医療費の増加がみられた（P値＜0.001）。合併症を有していない患者と比べ腎症を有する者は1.71倍の医療費となった。同様に網膜症を有する者は1.65倍，脳血管障害を有する者は1.33倍，心疾患を有する者は1.88倍の医療費となった。

糖尿病の入院患者において糖尿病の合併症が1か月当たりの医療費に与える影響を，共分散分析により解析した結果を表8に示す。

まず，性・年齢を共変量とし，1か月平均医療費の分析を行った。その結果，腎症の非合併群は482,303円，合併群では401,991円であり，腎症の合併群は非合併群に比べて80,312円の医療費低下がみられたが，有意ではなかった（P値＝0.50）。網膜症の非合併群は461,302円，合併群では

表6　糖尿病の合併症の組み合わせ状況

腎症	網膜症	神経障害	脳血管障害*	心疾患**	男性（%）	女性（%）	対象者数（%）
合併症なし							
−	−	−	−	−	760(52.2)	767(49.7)	1,527(50.9)
1群合併							
+	−	−	−	−	47(3.2)	54(3.5)	101(3.4)
−	−	+	−	−	64(4.4)	65(4.2)	129(4.3)
−	+	−	−	−	46(3.2)	58(3.8)	104(3.5)
−	−	−	+	−	139(9.6)	121(7.8)	260(8.7)
−	−	−	−	+	184(12.6)	227(14.7)	411(13.7)
2群合併							
+	−	+	−	−	10(0.7)	6(0.4)	16(0.5)
+	+	−	−	−	18(1.2)	12(0.8)	30(1.0)
+	−	−	+	−	7(0.5)	8(0.5)	15(0.5)
+	−	−	−	+	24(1.6)	16(1.0)	40(1.3)
−	+	+	−	−	6(0.4)	11(0.7)	17(0.6)
−	−	+	+	−	12(0.8)	14(0.9)	26(0.9)
−	−	+	−	+	14(1.0)	24(1.6)	38(1.3)
−	+	−	+	−	7(0.5)	7(0.5)	14(0.5)
−	+	−	−	+	8(0.5)	17(1.1)	25(0.8)
−	−	−	+	+	61(4.2)	75(4.9)	136(4.5)
3群合併							
−	+	−	+	+	3(0.2)	4(0.3)	7(0.2)
−	−	+	+	+	5(0.3)	15(1.0)	20(0.7)
−	+	+	−	+	1(0.1)	2(0.1)	3(0.1)
−	+	+	+	−	2(0.1)	2(0.1)	4(0.1)
+	−	−	+	+	13(0.9)	9(0.6)	22(0.7)
+	+	−	−	+	1(0.1)	2(0.1)	3(0.1)
+	+	−	+	−	2(0.1)	3(0.2)	5(0.2)
+	−	+	−	+	3(0.2)	7(0.5)	10(0.3)
+	−	+	+	−	2(0.1)	2(0.1)	4(0.1)
+	+	+	−	−	3(0.2)	6(0.4)	9(0.3)
4群合併							
+	+	+	+	−	1(0.1)	3(0.2)	4(0.1)
+	+	+	−	+	3(0.2)	1(0.1)	4(0.1)
+	−	+	+	+	4(0.3)	1(0.1)	5(0.2)
+	+	−	+	+	2(0.1)	1(0.1)	3(0.1)
−	+	+	+	+	2(0.1)	3(0.2)	5(0.2)
5群合併							
+	+	+	+	+	1(0.1)	1(0.1)	2(0.1)

* 脳血管障害は脳内出血，脳梗塞を含む
** 心疾患は虚血性心疾患，狭心症，急性心筋梗塞，心筋梗塞を含む

620,634円であり，網膜症の合併群は非合併群に比べて159,332円の医療費増加がみられたが有意ではなかった（P値＝0.40）。神経障害の非合併群は479,361円，合併群では360,900円であり，神経障害の合併群は非合併群に比べて118,461円の医療費低下がみられたが有意ではなかった（P値＝0.45）。脳血管障害の非合併群は468,575円，合併群では473,299円であり，脳血管障害の合併群は非合併群に比べて4,724円の医療費増加がみられたが有意ではなかった（P値＝0.96）。心疾患

表7　糖尿病患者の1か月間平均医療費構造（入院・外来）

	平均医療費（95%信頼区間）	
	性・年齢補正	多変量補正*
腎症		
なし	66,010 (58,551–73,470)	67,004 (59,635–74,453)
あり	124,946 (101,367–148,525)	114,623 (90,821–138,425)
差**	58,935	55,421
比***	1.89	1.71
*P*値	<0.001	<0.001
網膜症		
なし	67,356 (59,933–74,778)	67,848 (60,487–75,208)
あり	117,793 (92,558–143,028)	112,113 (86,709–137,516)
差**	50,437	44,265
比***	1.75	1.65
*P*値	<0.001	0.001
神経障害		
なし	71,047 (63,528–78,566)	72,241 (64,806–79,676)
あり	74,369 (51,622–97,116)	63,470 (40,796–86,143)
差**	3,322	−8,771
比***	1.05	0.88
*P*値	0.79	0.47
脳血管障害		
なし	66,123 (58,241–74,004)	67,346 (59,626–75,246)
あり	95,733 (78,555–112,910)	89,642 (72,544–106,740)
差**	29,610	22,296
比***	1.45	1.33
*P*値	0.002	0.02
心疾患		
なし	57,889 (49,690–66,087)	58,715 (50,543–66,888)
あり	112,992 (98,431–127,554)	110,441 (95,867–125,015)
差**	55,103	51,726
比***	1.95	1.88
*P*値	<0.001	<0.001

* 性・年齢・当該合併症以外の4つの合併症を共変量に組み入れる
** 合併症がある者の平均医療費－合併症がない者の平均医療費
*** 合併症がある者の平均医療費/合併症がない者の平均医療費
（脳血管障害は脳内出血，脳梗塞を含む）
（心疾患は虚血性心疾患，狭心症，急性心筋梗塞，心筋梗塞を含む）

表8　糖尿病患者の1か月間平均医療費構造（入院）

	平均医療費（95%信頼区間）	
	性・年齢補正	多変量補正*
腎症		
なし	482,303 (391,115–573,491)	494,367 (405,008–583,727)
あり	401,991 (187,451–616,531)	335,443 (120,828–550,059)
差**	−80,312	−158,924
比***	0.83	0.68
*P*値	0.50	0.18
網膜症		
なし	461,302 (375,059–547,545)	457,679 (373,324–542,033)
あり	620,634 (257,986–983,281)	683,537 (316,599–1,050,476)
差**	159,332	225,858
比***	1.35	1.49
*P*値	0.40	0.24
神経障害		
なし	479,361 (391,965–566,757)	483,453 (398,064–568,842)
あり	360,900 (62,267–659,533)	313,330 (17,054–609,606)
差**	−118,461	−170,123
比***	0.75	0.65
*P*値	0.45	0.27
脳血管障害		
なし	468,575 (367,491–569,659)	470,929 (372,311–569,547)
あり	473,299 (315,837–630,761)	467,728 (313,823–621,633)
差**	4,724	−3,201
比***	1.01	0.99
*P*値	0.96	0.97
心疾患		
なし	367,520 (265,911–469,130)	361,509 (259,387–463,632)
あり	663,184 (522,982–803,387)	674,519 (533,160–815,878)
差**	295,664	313,010
比***	1.80	1.87
*P*値	0.001	<0.001

* 性・年齢・当該合併症以外の4つの合併症を共変量に組み入れる
** 合併症がある者の平均医療費－合併症がない者の平均医療費
*** 合併症がある者の平均医療費/合併症がない者の平均医療費
（脳血管障害は脳内出血，脳梗塞を含む）
（心疾患は虚血性心疾患，狭心症，急性心筋梗塞，心筋梗塞を含む）

の非合併群は367,520円，合併群では663,184円であり，心疾患の合併群は非合併群に比べて295,664円の有意な医療費の増加がみられた（P値＝0.001）。

つぎに，性・年齢に加えてそれぞれの合併症を同時に共変量として投入した共分散分析を行った。その結果，腎症の非合併群は494,367円，合併群では335,443円であり，腎症の合併群は非合併群に比べて158,924円の医療費低下がみられたが有意ではなかった（P値＝0.18）。網膜症の非合併群は457,679円，合併群では683,537円であり，網膜症の合併群は非合併群に比べて225,858円の医療費増加がみられたが有意ではなかった（P値＝0.24）。神経障害の非合併群は483,453円，合併群では313,330円であり，神経障害の合併群は非合併群に比べて170,123円の医療費低下がみられたが有意ではなかった（P値＝0.27）。脳血管障害の非合併群は470,929円，合併群では467,728円であり，脳血管障害の合併群は非合併群に比べて3,201円の医療費低下がみられたが有意ではなかった（P値＝0.97）。心疾患の非合併群は361,509円，合併群では674,519円であり，心疾患の合併群は非合併群に比べて313,010円の有意な医療費の増加がみられた（P値＜0.001）。糖尿病の入院患者では，合併症を有していない患者と比べ心疾患を有する者は1.87倍の医療費となった。

糖尿病の外来患者において糖尿病の合併症が1か月当たりの医療費に与える影響を，共分散分析により解析した結果を表9に示す。

まず，性・年齢を共変量とし，1か月平均医療費の分析を行った。その結果，腎症の非合併群は34,774円，合併群では85,045円であり，合併群は非合併群に比べて50,271円の有意な医療費の増加がみられた（P値＜0.001）。網膜症の非合併群は36,856円，合併群では65,488円であり，網膜症の合併群は非合併群に比べて28,632円の有意な医療費増加がみられた（P値＜0.001）。神経障害の非合併群は37,774円，合併群では51,733円であり，神経障害の合併群は非合併群に比べて13,959円の有意な医療費増加がみられた（P値＜0.001）。脳血管障害の非合併群は38,635円，合併群では41,674円であり，脳血管障害の合併群は非合併群に比べて3,039円の医療費増加がみられたが有意ではなかった（P値＝0.24）。心疾患の非合併群

表9　糖尿病患者の1か月間平均医療費構造（外来）

	平均医療費（95%信頼区間）	
	性・年齢補正	多変量補正*
腎症		
なし	34,774 (32,898–36,650)	35,207 (33,352–37,061)
あり	85,045 (78,967–91,124)	80,505 (74,394–86,617)
差**	50,271	45,298
比***	2.45	2.29
P値	＜0.001	＜0.001
網膜症		
なし	36,856 (34,933–38,778)	37,511 (35,664–39,358)
あり	65,488 (58,969–72,008)	57,956 (51,597–64,315)
差**	28,632	20,445
比***	1.78	1.54
P値	＜0.001	＜0.001
神経障害		
なし	37,774 (35,816–39,733)	38,505 (36,640–40,370)
あり	51,733 (45,800–57,665)	45,047 (39,347–50,747)
差**	13,959	6,542
比***	1.37	1.17
P値	＜0.001	0.03
脳血管障害		
なし	38,635 (36,582–40,687)	39,102 (37,154–41,050)
あり	41,674 (37,076–46,273)	39,381 (34,997–43,764)
差**	3,039	279
比***	1.08	1.01
P値	0.24	0.91
心疾患		
なし	35,614 (33,483–37,746)	35,889 (33,850–37,929)
あり	50,495 (46,634–54,357)	49,613 (45,906–53,321)
差**	14,881	13,724
比***	1.42	1.38
P値	＜0.001	＜0.001

* 性・年齢・当該合併症以外の4つの合併症を共変量に組み入れる
** 合併症がある者の平均医療費－合併症がない者の平均医療費
*** 合併症がある者の平均医療費/合併症がない者の平均医療費
（脳血管障害は脳内出血，脳梗塞を含む）
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