

A study on the relationship between causes of death and community-based health examinations

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In 1988, 564 people (286 males and 278 females) died in Gamagori, a city with a population of about 85,000 in Aichi prefecture. Among them, 538 (270 males and 268 females), aged 41 years or over, were surveyed in this study. Of that number, 130 (70 male and 60 females) received health examinations from 1983 to 1987 (an average of 2.3 times in 5 years) and their mean age was approximately 70 years. They were compared with those who did not receive health examinations and the relationship between causes of death and health examinations was investigated. There were no significant differences in the age distribution and the causes of death between them. A case-control study (1:1) was also undertaken. The control subjects were selected matching the gender and the age (birth date) from the living subjects who received health examinations. There were significant differences in hypertension and a history of hypertension among patients that died from strokes and their matched pair.

INTRODUCTON

A periodic health visit is an important opportunity for the community to receive clinical preventive services. Determining the specific preventive services that are most appropriate for inclusion in the periodic health examination was one of the principal objectives of the US Preventive Services Task Force (USPSTF) project¹⁾. The recommendations, based on a comprehensive review of the science, provide guidance on how to design an appropriate package of services based on the medical history and risk profile of each patient. It includes the guide for screening for hypertension, obesity, diabetes mellitus, hyperlipidemia and heart disease. In Japan, municipalities usually provide community-based periodic health checkups for the middle aged and

elderly, and it is necessary to give suitable screenings and appropriate counseling to the residents.

Since the number of aged people is gradually increasing not only in Japan but around the world, preventive medical services for cancer, coronary heart disease and strokes will rise in importance. In Japan, health examinations according to the Health Services for the Elderly Act were established in 1982 under the responsibility of municipalities, for the early detection and treatment of diseases. These health examinations have two parts: a basic medical checkup and a cancer screening. This study was conducted to examine the relationship between the causes of death and health examinations for the middle aged and elderly residents.

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SUBJECTS AND METHODS

1. Study on Health Examination

The subjects chosen were 538 people (male 270, female 268) who were residents in Gamagori city, Aichi prefecture, who died in 1988 and whose age at death was over 41. The total number of deaths numbered 564 (male 286, females 278). Gamagori city has a population of 85,000 citizens and carries out health examinations for citizens using private clinics and hospitals that the citizens themselves choose. Based on the above mentioned subjects, we surveyed the rate of health checkups at clinics using the City Adult Health Examination records, from 1983 to 1987. The subjects were classified into groups that either received or did not receive health examinations (screened and non-screened, respectively) for the five years before death. The data were further classified into age distributions, and the ratios of specific causes of death to all deaths were calculated. Using these data, we were able to analyse the relationship between the results of health checkups and the causes of death.

2. Case-Control Study

We matched the subjects who received health checkups and died from either heart diseases or strokes with control subjects who were alive in 1988. They were paired (1:1) according to date of birth and gender in the city health examination records. We analysed both the deceased group's and the living group's health examination results.

RESULTS

1. Study on Health Examination

Table 1 shows the trends in people receiving health checkups for adult diseases in Gamagori city. It lists the surveyed five years, the number of people who were eligible to receive health checkups, the actual number of people who had health checkups and the rate of visits.

Table 2 shows the trends in receiving health examinations for cancers, stomach cancers and lung cancers. When compared with all Japan data, the rate of visits in Gamagori city was considerably lower, except for 1984. The rates of visits for cancers in Gamagori city were lower than the average for all Japan.

Table 1. Trends in City Adult Health Examination for Gamagori.

Year	1983	1984	1985	1986	1987
Number eligible for examinations	24,688	24,884	25,463	25,867	26,370
Actual number examined	4,539	5,991	5,985	5,886	6,853
Percentage	18.4	24.1	23.5	22.8	26.0

Table 2. Trends in City Adult Health Examination for cancers in Gamagori.

Year	1984	1985	1986	1987
No. eligible for cancer examinations	24,884	25,463	25,867	26,370
Actual no. of stomach cancer screenings	1,660	1,690	1,859	2,461
Percentage	6.7	6.6	7.2	9.3
Actual no. of lung cancer screenings	2,398	2,797	2,558	3,390
Percentage	9.6	11.0	9.9	12.9

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Table 3. Screening among case subjects in 1988 by age and sex distribution

Age groups	Male		Female	
	Screened	Not Screened	Screened	Not Screened
41-49	3 (4.3)	10 (5.0)	3 (5.0)	11 (5.3)
50-59	6 (8.6)	34 (17.0)	5 (8.3)	15 (7.2)
60-69	14 (20.2)	33 (16.5)	16 (26.7)	32 (15.4)
70-79	28 (40.0)	53 (26.5)	14 (23.3)	62 (29.8)
80-89	17 (24.2)	61 (30.5)	21 (35.0)	58 (27.9)
90-	2 (2.9)	9 (4.5)	1 (1.7)	30 (14.5)
Total	70 (100)	200 (100)	60 (100)	208 (100)
Mean Age	71.8±10.7	71.5±12.6	72.4±12.2	75.8±13.4
	(T test, N.S.)		(T test, p<0.1, N.S.)	

Figures in () represent %

Table 3 shows the age distribution among the subjects by gender and the number that received or did not receive health checkups. During the final five years, 70 males (25.9%) and 60 females (22.4%) received health examinations. The average age at screening was 71.8±10.7 and 72.4±12.2 years, for males and females, respectively. For the non-screened subjects, their average ages were 71.5±12.6 and 75.8±13.4 years, for males and females, respectively. In males there was little difference in age distribution in the non-screened and screened group. However, in females, the average age of the non-screened subjects was older by 3.4 years. This was not statistically different.

Table 4 shows the major causes of death in 1988 for the 538 subjects, classified into people who did and did not go for health checkups. For males, the ratios of deaths from heart diseases were 17.1% and 24.5% for the screened and non-screened groups, respectively. In females, these figures were 26.7% and 26.9%. For males, the figure for non-screened males was larger,

Table 4. Major causes of death among case subjects in 1988

	Sex	Screened	Not Screened
Malignant neoplasms	M	28 (40.0)	69 (34.5)
	F	18 (30.0)	41 (19.7)
Heart disease	M	12 (17.1)	49 (24.5)
	F	16 (26.7)	56 (26.9)
Cerebrovascular diseases	M	9 (12.9)	22 (11.0)
	F	11 (18.3)	45 (21.6)
Others	M	21 (30.0)	60 (30.0)
	F	15 (25.0)	66 (31.8)

Figures in () represent %

although for the female subjects, this figure was almost identical. The ratios of deaths from stroke for males were 12.9% and 11.0% for the screened and non-screened groups respectively. In females, these figures were 18.3% and 21.6%. The figures here were similar to each other. In males, the ratios of deaths from cancers were 40.0% and 34.5% for the screened and non-screened groups, respectively. In females, these figures were 30.0% and 19.7%.

We performed statistical analysis using χ^2 test. There were no significant differences between the causes of death and the rates of visit for both genders.

Table 5 shows the frequency of visits among the screened group (130 subjects) classified into major causes of death and gender. For all deaths, about 2 visits were made in the final five years.

Table 6 shows the number of screened subjects by frequency of visits and gender. 28.6% of males and 21.7% of females visited their clinic or hospital more than three times.

Table 7 shows the survival years for both the first and the final visits for males and females according to disease, until death. It can be seen that the period from the first visit until death was about 3 years and between the final visit and death, approximately 2 years.

Table 8 shows the results of adult health checkups. The diagnosis equipment and examinations used to treat the various diseases are listed with the total number of deaths, as is the number of people who underwent a certain medical examination and those who were found to have the disorders. We note that blood pressure was measured in all examinees and among the 20 dead subjects from strokes, 15 were found to be hypertensive (including borderline hypertension). Among the 28 dead subjects from heart disease, 11 were found to be hypertensive (including borderline hypertension).

2. Case-control study

As mentioned in the Methods, we chose the subjects who received health checkups and died from heart diseases and strokes, and then we matched them with control subjects who were alive in 1988. They were matched according to date of birth and gender. We analysed both the case study group and the control group from the results of these health checkups.

Table 5. The number of visits for health screenings among case subjects

	Cancers	Heart disease	Cerebrovascular disease	All deaths
Male	1.96±1.24	1.86±0.83	2.33±1.70	2.01±1.20
Female	1.78±0.85	1.63±0.93	2.09±1.08	1.80±1.01

(Mean±SD)

Table 6. Number of visits for health screenings among case subjects

No. of visits	5	4	3	2	1	Total
Male	3	8	9	18	32	70
Female	1	4	8	16	31	60

Table 7. Survival years after both the first and final screenings.

	Cancers	Heart disease	Cerebrovascular disease	All deaths
Male	3.32±1.17 2.32±1.23	3.07±1.33 1.86±1.12	3.00±1.63 1.67±1.25	3.14±1.29 1.99±1.18
Female	3.72±1.15 2.39±1.16	3.19±1.38 2.25±1.44	3.45±1.30 2.09±0.79	3.48±1.36 2.33±1.29

(Mean±SD)

Upper figures: first visit; lower figures: final visit

Table 8. The results of health screenings classified by causes of death.

Cause of death	Related examination	No. of deaths	No. examined	No. of abnormalities detected
Lung cancer	Chest X-ray	5	3	1
Stomach cancer	UGI	15	3	1
Heart disease	Hypertension	28	28	11
	ECG	28	19	14
	T. Chol	28	24	4
	HDL-C	28	20	7
Cerebrovascular disease	Hypertension	20	20	15
	ECG	20	15	9
	T. Chol	20	19	6
	HDL-C	20	15	7

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Table 9. Comparison of findings in the first screening between deaths from cerebral vascular diseases and controls

Findings		Abnormalities			χ^2 -test	Odds Ratio (95% C.I.)
		Present	Absent	Total		
Hypertensive history	Case	12	7	19	3.83	4.39 (0.99-24.79)
	Control	5	14	19		
Hypertension	Case	10	9	19	4.21*	5.21 (1.06-37.02)
	Control	3	16	19		
Diabetes Mellitus History	Case	1	18	19	0.00	
	Control	0	19	19		
Obesity	Case	5	14	19	3.47	
	Control	0	18	18		
High total cholesterol	Case	2	13	15	0.00	1.07 (0.089-13.08)
	Control	2	14	16		
Low HDL-C	Case	3	8	11	0.012	1.73 (0.18-21.99)
	Control	2	10	12		
Abnormal ECG	Case	5	8	13	0.00	0.88 (0.13-5.79)
	Control	5	7	12		

*p<0.05

Table 9 shows the findings of the case and their matched controls' examinations for the year in which the first visit was made, for strokes. For the abnormality definitions, total cholesterol levels over 230 mg/dl and HDL cholesterol levels equal or less than 30 mg/dl, were considered abnormal. Electrocardiograms were used to determine abnormalities with standards established by the Japan Public Health Association²⁾. For stroke patients who died and their matched controls, there were significant differences (p<0.05) in both having past histories and present cases of hypertension.

Table 10 shows the findings of the case and their matched control examinations for the year in which the first visit was made, for heart disease. There were no significant differences between those two groups.

Table 11 shows the findings of the case and their matched control examinees' examinations for the year in which the final visit was made, for strokes. For stroke patients, there were significant differences (p<0.01) in having a history of hypertension between cases and controls.

Table 12 shows the findings of the case and their matched control examinations for the year in which the final visit was made, for heart disease. There were no significant differences in having a history of hypertension nor having present hypertension.

The number of deaths from malignant neoplasms was 156 in 1988. Among them, 46 (male 28, female 18) received health checkups during the final five years. These various cancers consisted of 15 stomach cancers, 4 rectal cancers, 4 liver cancers, 4 pancreatic cancers, 5 lung

Table 10. Comparison of findings in the first screenings between deaths from heart disease and controls

Findings		Abnormalities			Total χ^2 -test	Odds Ratio (95% C.I.)
		Present	Absent	Total		
Hypertensive history	Case	6	22	28	0.79	0.51 (0.13-1.86)
	Control	10	18	28		
Hypertension	Case	4	24	28	1.10	0.42 (0.083-1.77)
	Control	8	19	27		
Diabetes Mellitus History	Case	3	25	28	0.27	2.52 (0.27-86.63)
	Control	1	27	28		
Obesity	Case	4	24	28	1.00	
	Control	4	24	28		
High total cholesterol	Case	2	15	17	0.00	1.06 (0.090-12.62)
	Control	2	16	18		
Low HDL-C	Case	4	12	16	0.81	3.48 (0.38-126.21)
	Control	1	14	15		
Abnormal ECG	Case	12	3	15	1.24	2.89 (0.54-20.90)
	Control	10	8	18		

Table 11. Comparison of findings in the final screenings between deaths from cerebral vascular diseases and controls

Findings		Abnormalities			Total χ^2 -test	Odds Ratio (95% C.I.)
		Present	Absent	Total		
Hypertensive history	Case	11	8	19	9.87**	16.69 (2.44- ∞)
	Control	1	18	19		
Hypertension	Case	11	8	19	1.70	2.81 (0.66-14.16)
	Control	6	13	19		
Diabetes Mellitus History	Case	3	16	19	1.45	
	Control	0	19	19		
Obesity	Case	5	14	19	1.60	4.43 (0.55-154.66)
	Control	1	17	18		
High total cholesterol	Case	2	15	17	0.59	
	Control	0	18	18		
Low HDL-C	Case	3	12	15	0.22	2.52 (0.24-93.73)
	Control	1	13	14		
Abnormal ECG	Case	9	6	15	2.52	4.38 (0.75-37.54)
	Control	3	10	13		

**p<0.01

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Table 12. Comparison of findings in the final screenings between deaths from heart disease and controls

Findings		Abnormalities			χ^2 -test	Odds Ratio (95% C.I.)
		Present	Absent	Total		
Hypertensive history	Case	7	21	28	0.00	0.84 (0.22-3.17)
	Control	8	20	28		
Hypertension	Case	4	23	27	0.83	0.46 (0.092-1.95)
	Control	8	20	28		
Diabetes Mellitus History	Case	2	26	28	0.00	1.00
	Control	2	26	28		
Obesity	Case	2	24	26	0.00	0.74 (0.073-5.81)
	Control	3	25	28		
High total cholesterol	Case	0	21	21	0.00	1.00
	Control	0	23	23		
Low HDL-C	Case	6	11	17	0.45	2.07 (0.40-12.37)
	Control	4	16	20		
Abnormal ECG	Case	11	5	16	0.90	2.29 (0.51-11.90)
	Control	10	11	21		

cancers, 2 uterine cancers and 12 other cancers. In this city, 2 (1 stomach and 1 lung cancer patient) case subjects were found to have cancers in the health examinations. In this study, we could not compare the case subjects from cancers and controls because of the small number of patients.

DISCUSSION

The significance of high blood pressure to cardio- and cerebrovascular disease is well recognized, and therefore there are many reports in various countries. From a comparison of results of a national cholesterol and blood pressure screening with the NHANES II Study, Fridinger et al³⁾ suggested both serum cholesterol and blood pressure and levels in the USA might not have decreased appreciably in the past decade, and that continued national, state and local

public health efforts to modify behaviors related to hypercholesterolemia and hypertension were warranted. Zulkifli⁴⁾ reviewed some of the findings of studies on blood pressure tracking (the phenomenon of persisting at the same rank). Blood pressure tracking allows for the possible identification of high risk groups, for whom early intervention can be initiated. With regard to borderline arterial hypertension (BH), Kawecka reported⁵⁾ on the natural course and prognostic significance of BH. He indicated that a relation between the ability to work and blood pressure became more prominent while taking into account final diagnosis, i.e. 65.7% of actual normotensives, 56.4% of the patients with BH and 47.5% with hypertension continued their work and that the highest rate was found when BH combined with other coronary risk factors. Numerous reports on relations between blood pressure and

other cardiovascular risk factors have been published⁶⁻¹⁰, e.g. Stamler et al¹¹) indicated that systolic blood pressure was more strongly associated with coronary heart disease than was diastolic blood pressure and that the risk of coronary death increased among hypertensive men who had elevated serum cholesterol levels or smoked cigarettes.

Thus far, few reports relating between the causes of death and health examination have been published. In our findings, for stroke patients who died and their matched control, there were significant differences in both having past histories and present hypertensive disease. For cardiovascular disease patients, there were no significant differences in having a history of hypertension nor having present hypertension between those two groups. The frequency of visits among the screened group who died from heart disease and strokes (48 subjects) was about twice in the final 5 years. To decrease risks of death among hypertensive patients with end-organ damage, the importance of early preventive treatments is emphasized. In this study, we did not detect a significant positive relationship between hypertension and serum cholesterol.

There have been previous recommendations¹²) and reflections¹³) on community-based health screenings. Tataru et al¹⁴) reported that good quality health services for the middle aged decrease the demand for inpatient care for the elderly. With the greying of Japan, the government cannot afford to overlook this point. Our findings have implications for the design of health examinations and clinical practice, as it is apparent that hypertension is a positive significant factor related to death by strokes. For continuing medical services following a community-based screening, a network system of hospitals and physicians should be developed¹⁵), by which the information

on visits to outpatient clinics after screening, is collected, analyzed and monitored periodically.

Mortality and morbidity of malignant neoplasms are a major public health problem. Especially with regard to lung cancer, numerous reports^{1),16)-21}) on the efficacy of its mass-screening have been published. Against many conflicting reports, Sobue et al^{19),21}) indicated that the matched case-control study suggested some benefits from lung cancer screening in terms of reduction of lung cancer mortality.

In our study, we could not compare the case subjects and controls with regard to cancer because of the small number of patients. The efficacy of cancer screenings should be further investigated.

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