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Short Communication

Preventive Strategy for Hypertension Based on Attributable Risk Measures

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Abstract

Objectives: To examine the effective preventive strategy for hypertension in a Japanese male population, based on attributable risk measures.

Methods: A 7-year follow-up study of hypertension among 6,306 middle-aged male office workers in a Japanese telecommunication company.

Results: In terms of population attributable risk percentage (PAR%), regular alcohol intake and physical inactivity showed great contributions to the development of hypertension in the population no less than obesity. The PAR% of each risk factor varied by age group, and the total PAR% of the three modifiable risk factors was considerably higher in the 30–39 year old group (71%) than in the older groups.

Conclusions: Reduced alcohol intake and increased physical activity, as well as weight control, may have a larger impact on prevention of hypertension in younger groups than in older groups.

Key words: primary prevention, attributable risk, follow-up study, hypertension, risk factors

Introduction

Epidemiological studies have provided valuable information on risk factors of chronic diseases. Relative risk (RR) and attributable risk (AR) are often used to estimate the magnitude of the disease risk (1). A high RR indicates a major role in the causation of disease, and RR measures can offer appropriate criteria for a high-risk individual who requires intensive interventions to minimize the disease risk. On the other hand, a high AR indicates a great potential to prevent the disease in populations, and AR measures can offer appropriate guidelines for public health recommendations. Neither risk measure is a substitute for the other (1). Although major studies have so far focused on RR rather than AR (2), epidemiological findings with RR alone provide insufficient information for evidence-based public health. The present study aimed to examine the effective preventive strategy for hypertension in a Japanese male population, based on attributable risk measures.

Subjects and Methods

A cohort of normotensive male office workers aged 30 to 59 years (n=6,306) was followed up between 1991 and 1998 inclusive to observe the development of hypertension (either initiation of antihypertensive therapy or a systolic blood pressure ≥140 mmHg and/or a diastolic blood pressure ≥90 mmHg (3)), using annual health examination data of a Japanese telecommunication company (4).

The participants in the annual health examination were asked to complete a structured and comprehensive questionnaire about their health conditions and lifestyles. Questions about alcohol drinking included weekly frequency of alcohol intake and that about physical activity included with or without regular exercise. Height and weight were measured while wearing an examining gown without shoes. Systolic and diastolic blood pressures were measured after five minutes of rest in a sitting position by well-trained nurses. For those with a systolic blood pressure ≥140 mmHg and/or a diastolic blood pressure ≥90 mmHg, blood pressure was measured again after an additional five minutes of rest. Blood samples (fasting) were taken for measurements of biochemical variables. The above processes were conducted according to the guidelines established by the employee health management center of the company (4). Table 1 shows the baseline characteristics of the study subjects. Blood pressure, body mass index and fasting blood glucose were classified according to the Japanese expert committees' guidelines: high-normal blood pressure was defined as a systolic blood pressure of 130–139 mmHg and/or a diastolic blood pressure of 85–89 mmHg (3); obesity was defined as a body mass index ≥25 kg/m^2 (5); glucose intolerance was defined as taking antihyperglycemic therapy or a fasting blood glucose ≥110 mg/dl (6). Based on information collected through the questionnaire, those with alcohol drinking ≥5 days/week were classified as regular alcohol intake and those without regular exercise were classified as physical inactivity.

Multivariate analyses were performed using the Cox's proportional hazard models (7). The AR of each risk factor was

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Table 1 Baseline characteristics of study subjects

factor	all subjects (n=6306)		age (y) 30–39 (n=561)		40–49 (n=5283)		50–59 (n=462)	
	n	%	n	%	n	%	n	%
blood pressure, mmHg†								
<120/80 (optimal)	2,530	40.1	213	38.0	2,156	40.8	161	34.8
120–129/80–84 (normal)	1,869	29.7	184	32.8	1,553	29.4	132	28.6
130–139/85–89 (high-normal)	1,907	30.3	164	29.2	1,574	29.8	169	36.6
body mass index, kg/m^2‡								
<18.5 (thin)	242	3.8	20	3.6	203	3.8	19	4.1
18.5–24.9 (normal)	4,752	75.4	393	70.1	4,005	75.8	354	76.6
25≤(obese)	1,312	20.8	148	26.4	1,075	20.3	89	19.3
fasting blood glucose, mg/dl§								
<110 (normal)	5,804	92.1	529	94.3	4,871	92.2	404	87.4
110≤(glucose intolerance)	502	8.0	32	5.7	412	7.8	58	12.6
alcohol drinking								
<5 days/week (no regular intake)	1,804	28.6	147	26.2	1,494	28.3	163	35.3
≥5 days/week (regular intake)	4,502	71.4	414	73.8	3,789	71.7	299	64.7
physical activity								
regular exercise (active)	852	13.5	69	12.3	718	13.6	65	14.1
no regular exercise (inactive)	5,454	86.5	492	87.7	4,565	86.4	397	85.9

† classified according to the expert committee' guidelines from the Japanese Society of Hypertension.
‡ classified according to the expert committee' guidelines from the Japanese Society of Obesity.
§ classified according to the expert committee' guidelines from the Japanese Society of Diabetes Mellitus.

estimated by population attributable risk percentage (PAR%) from Levin's formula (8).

Results and Discussions

After adjusting for age at the baseline, obesity, regular alcohol intake and physical inactivity, in addition to high-normal blood pressure at the baseline and glucose intolerance, were recognized as independent risk factors of hypertension. Table 2 shows the RR and PAR% of each risk factor. In terms of RR, obesity (1.52, 95%CI: 1.38–1.66) was ranked first among the three modifiable risk factors; regular alcohol intake (1.21, 95%CI: 1.10–1.34) and physical inactivity (1.17, 95%CI: 1.03–1.33) followed after obesity. On the other hand, in terms of the PAR%, regular alcohol intake (13%, 95%CI: 7–20%) and physical inactivity (13%, 95%CI: 3–22%) were ranked beside obesity (10%, 95%CI: 7–12%).

Although lifestyles and obesity often play minor roles in the

Table 2 Relative risks and population attributable risk percentages for development of hypertension

factor	all subjects (n=6306)		age (y) 30–39 (n=561)		40–49 (n=5283)		50–59 (n=462)	
	RR† (95%CI)	PAR%‡ (95%CI)	RR† (95%CI)	PAR%‡ (95%CI)	RR† (95%CI)	PAR%‡ (95%CI)	RR† (95%CI)	PAR%‡ (95%CI)
high-normal blood pressure§	3.62 (3.32–3.94)	44 (41–47)	3.35 (2.29–4.90)	41 (27–53)	3.73 (3.40–4.09)	45 (42–48)	3.13 (2.30–4.25)	44 (32–55)
obesity§	1.52 (1.38–1.66)	10 (7–12)	1.72 (1.18–2.50)	16 (4–28)	1.57 (1.42–1.74)	10 (8–13)	1.08 (0.76–1.53)	1 (0–9)
glucose intolerance§	1.13 (0.98–1.29)	1 (0–2)	1.79 (1.05–3.06)	4 (0–11)	1.07 (0.92–1.25)	1 (0–2)	1.28 (0.86–1.92)	3 (0–10)
regular alcohol intake§	1.21 (1.10–1.34)	13 (7–20)	1.30 (0.82–2.06)	18 (0–44)	1.16 (1.04–1.30)	11 (3–18)	1.47 (1.05–2.06)	23 (3–41)
physical inactivity§	1.17 (1.03–1.33)	13 (3–22)	1.68 (0.89–3.22)	37 (0–66)	1.20 (1.04–1.38)	15 (4–25)	0.82 (0.56–1.22)	— (0–16)

RR: relative risk, PAR%: population attributable risk percent, CI: confidence interval.
† calculated using the Cox's proportional hazards model, included simultaneously age(y) and all factors listed in the table.
‡ calculated using Levin's formula.
§ refer to Table 1.

causation of disease (low RR), their prevalence rates are high (high AR): in the present study, regular alcohol intake, physical inactivity and obesity accounted for 71% and 87% and 21%, respectively. Rose has suggested two approaches for disease prevention, that is, a high-risk strategy and a population strategy (9). If means of improving a risk factor are safe enough for public health recommendations, the latter approach is reasonable in those with low RR and high AR rather than the former approach (9). Magnitude ranking based on AR measures (obesity=regular alcohol intake=physical inactivity) was different from that based on RR measures (obesity>regular alcohol intake=physical inactivity). Accordingly, priorities in preventive strategies for hypertension should be different between the high-risk approach (i.e. weight control is important) and the population approach (i.e. reduced alcohol intake and increased physical activity, as well as weight control, are important).

Moreover, the PAR% varied by age group with variations in both the prevalence rate and the RR of each risk factor (Table 2). The contribution of physical inactivity was greatest in the 30–39 years old group (37%), whereas that of regular alcohol intake was greatest in the 50–59 years old group (23%). The total PAR% of the modifiable risk factors was considerably higher in the 30–39 years old group (71%) than in the older groups.

To promote a more effective preventive strategy for hypertension in the population, health professionals should change their target risk factors by age group: increased physical activity should be focused in the younger group; reduced alcohol intake should be focused in the older group. Due to the high total PAR% of the three modifiable risk factors in the 30–39 years old group, reduced alcohol intake and increased physical activity, as well as weight control, may have a larger impact on prevention of hypertension in the younger group than in the older groups. This reconfirms the importance of early health education regarding good lifestyles and ideal weight for the primary prevention of the disease.

Due to using the annual health examination data of a company, the present study has the following potential limitations. First, the definitions of the population at risk and the cases of developing hypertension depended on casual blood pressure readings. As stated in previous studies, variability in measurements of casual blood pressure makes it difficult to establish both normotension at the baseline and subsequent development of hypertension (3, 10). However, the diagnosis of hypertension in this study was based on two measurements of blood pressure. Second, those who had retired or had been transferred to another locality (censored cases) were more likely to be seen in the 50–59 years old group. However, the mean (SD)s of the follow-up duration in the 30–39, 40–49 and 50–59 years old groups were 6.7 (0.8), 6.4 (1.3) and 6.3 (1.3) years, respectively, and there was no significant difference among them. Thus, the sampling bias might have negligible effects on the findings of this study. Finally, only qualitative information on alcohol drinking and physical activity was used in the risk estimation. Previous studies suggested dose-response relation of alcohol intake and physical activity in the development of hypertension (11–13). Moreover, some other lifestyles have been identified as risk factors of hypertension. In addition to weight control, increased physical activity, and reduced alcohol intake, reduced salt intake is recommended as a non-pharmacological intervention on blood pressure (3, 14, 15). Lifestyle modifications may have a greater impact on the prevention of hypertension than that expected in the present study. Further studies may be required to improve the risk estimation.

Risk assessment based on population characteristics is important for evidence-based public health. Health professionals need useful risk measures in the population for judgment of target risk factors. Despite of the potential limitations of the present study, the AR measures by age group can provide valuable information for a population strategy.

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