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Determinants of Control of High Blood Pressure. The Oslo Health Study 2000–2001

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Objective: To examine determinants of control of high blood pressure in Oslo, Norway. *Methods:* The Oslo Health Study 2000–2001, a population-based survey, included 6301 men and 7645 women born in 1924/25, 1940/41, 1955 and 1960 that were screened for high blood pressure and other cardiovascular risk factors. Uncontrolled high blood pressure was defined as systolic >140 mmHg or diastolic >90 mmHg or both. *Results:* Use of antihypertensive drugs was 4.1% at age 40–45 years, 19.1% at age 60 years and 35.8% at age 75 years. Among pharmacologically treated subjects with diabetes or cardiovascular disease (CVD), one-third of subjects aged 40–45 years, over one-half of those aged 60 years and nearly two-thirds of those aged 75 years had uncontrolled high blood pressure. These proportions were 8–13 percentage points higher in subjects without diabetes or CVD. Among pharmacologically treated men, younger age, use of statins, body mass index below 25 kg/m^2, and CVD or diabetes were associated with a lower risk of uncontrolled high blood pressure. Among treated women, younger age and cigarette smoking were associated with a lower risk ($p < 0.05$). *Conclusion:* The presence of CVD or diabetes and the prescription of cholesterol-lowering statins were independently associated with better control of blood pressure. Non-smoking women were more likely to have uncontrolled high blood pressure than their smoking counterparts. *Key words: antihypertensive treatment, blood pressure control, cardiovascular disease, diabetes, population-based survey.*

INTRODUCTION

Hypertension is the commonest cardiovascular disorder affecting about 44% of Europeans aged 35–74 [1]. Treatment of hypertension leads to large benefits, in terms of avoided coronary heart disease, stroke, congestive heart failure and renal dysfunction. Control programmes have focused on primary prevention, early detection and adequate treatment. Most recently, updated guidelines from the European Society of Hypertension/European Society of Cardiology and the US Joint National Committee have been published [2, 3]. While many experts agree that treatment for hypertension should achieve blood pressure levels below 140/90 mmHg (and that patients with diabetes or renal impairment should achieve even lower levels), these aims are usually not reached [4, 5]. Physicians often desist from changing blood pressure regimens [6], consider guidelines too difficult to implement or not intended for their patients, or may be overcome by clinical inertia and confusion about the discrepancies of clinical guidelines [7–9]. Patient compliance, lifestyle factors and the heterogenic nature of the response of blood pressure level to antihypertensive therapy are additional impediments to reaching targets in hypertension treatment [10, 11].

Nationwide screening programmes of cardiovascular risk factors in Norway have historically not included the city of Oslo [12]. In the setting of a capital city with good medical care, other factors than access may play a role in how well hypertension is treated. The Oslo Health Study 2000–2001 was a population-based survey of the health status and medication use of selected birth cohorts living in Oslo in 2000–2001. Our objectives were firstly to describe the use of antihypertensive drugs and level of blood pressure among men and women that participated in the survey and secondly to establish the determinants of control of high blood pressure.

METHODS

The Oslo Health Study 2000–2001 was a collaboration between the National Health Screening Service of Norway (now the Norwegian Institute of Public Health), the University of Oslo and the municipality of Oslo. All individuals in the county of Oslo born in 1924/25, 1940/41, 1955, 1960 and 1970 were invited to take part in the study. In this report, subjects born in 1924/25 and 1940/41 are referred to as 75- and 60-year old individuals, respectively. Subjects born in 1970 are not included because only 1.3% of men and 1.2% of women in this age

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Table I. *Subject characteristics, percentages or mean (SD) values are shown, the Oslo Health Study 2000–2001*

	Men, *n*	Women, *n*
n		
40 or 45 years	2833	3513
60 years	2016	2211
75 years	1452	1921
Demographics, %		
Lives alone	36.6	48.9
Full or part-time work	86.1	80.5
Visited general practitioner during the last year	66.1	78.4
Current cigarette smokers	26.0	26.0
Medical history, %		
Cardiovascular disease (heart attack, angina, stroke)	11.3	6.8
Diabetes	4.5	3.0
Risk factor levels, mean ± SD		
Number of cigarettes (daily smokers)	14.3 ± 7.9	12.1 ± 6.2
Body mass index, kg/m^2	26.6 ± 3.6	25.6 ± 4.5
Systolic blood pressure, mmHg	136 ± 18	133 ± 21
Diastolic blood pressure, mmHg	81 ± 11	74 ± 12
Total cholesterol, mmol/l[a]	5.8 ± 1.2	5.8 ± 1.1
High density lipoprotein cholesterol, mmol/l[a]	1.3 ± 0.4	1.7 ± 0.4
Triglycerides, mmol/l[a]	1.9 ± 1.4	1.4 ± 0.9
Glucose, mmol/l[a]	5.7 ± 1.7	5.4 ± 1.4

[a]Blood tests were non-fasting.

group reported use of antihypertensive drugs. The response rate was 52% and 39% for women and men, respectively, in the 40- and 45-year age group, 57% and 53%, respectively, in the 60-year age group and 50% and 58%, respectively, in the 75-year age group after up to two reminders were sent. The study protocol was evaluated by the Regional Ethics Committee and approved by the Norwegian Data Inspectorate. The study was conducted in accordance with the Helsinki Declaration of 1975 (1983 revision).

Baseline measurements included height, weight, blood pressure and non-fasting analyses of serum total cholesterol, HDL cholesterol, triglycerides and glucose. Blood pressure was measured by the Dinamap (Criticon, Tampa, USA), an automatic oscillometric blood pressure measurement device. After the subject rested in the sitting position for 5 min, three recordings were made at 1-min intervals. The mean of the second and third measurements was used in all analyses.

One self-administered questionnaire was part of the letter of invitation. In addition, two questionnaires were handed out at the site of the survey and were to be sent back in a stamped addressed envelope. The questionnaires provided information on health status, symptoms, diseases, health behaviours and use of medications. In regard to health status, participants were asked to check yes or no as to whether they had experienced a number of illnesses including diabetes, heart attack, angina pectoris and stroke. Subjects were asked whether they presently took antihypertensive drugs, had taken a drug previously but not at present or had never taken a drug, and to list the names of drugs used for hypertension. In addition, they were asked whether one or more of their parents or siblings had experienced a myocardial infarction or angina pectoris. The complete questionnaire may be accessed at http://www.fhi.no/.

Of a total of 6578 men and 8078 women that participated in the survey in the defined age groups, 6415 of men (97.5%) and 7785 of women (96.4%) had responded to the question on health status and could be classified for the purposes of this study as either presumed healthy or having had at least one of diabetes, heart attack, angina or stroke. Of these subjects, 98.2% of both genders also could be classified as users or non-users of antihypertensive drugs. This left a total of 6301 men and 7645 women in the study, of whom 905 men and 707 women reported a history of heart attack, angina, stroke or diabetes (or a combination). Of men, 79% of drug users reported the name of the specific drug(s), and of women, 87% reported the specific drug(s). One drug was named by 59% of men and 62% of women who gave names, while two drugs were named by 31% of men and 32% of women. The rest named three or more drugs. The dosage was not recorded.

Statistical methods

Uncontrolled high blood pressure was defined as systolic blood pressure >140 mmHg or diastolic blood pressure >90 mmHg or both. Confidence intervals for proportions were calculated using the continuity corrected version of

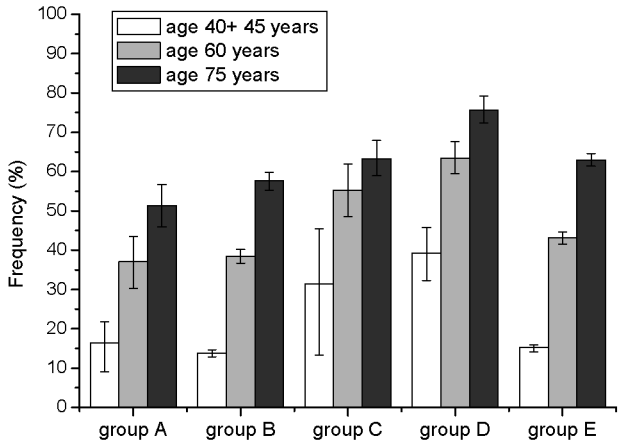

Fig. 1. Prevalence and confidence interval of systolic blood pressure >140 mmHg or diastolic blood pressure >90 mmHg or both in subjects with or without cardiovascular disease (CVD) or diabetes. Group A, subjects with CVD or diabetes not taking antihypertensive drugs; group B, subjects without CVD or diabetes not taking antihypertensive drugs; group C subjects with CVD or diabetes taking antihypertensive drugs; group D, subjects without CVD or diabetes taking antihypertensive drugs and group E, all subjects, the Oslo Health Study 2000–2001.

the score [13]. Bivariate associations were evaluated using χ^2 tests. Odds ratios with 95% confidence intervals (CI) were estimated separately for men and women through logistic regression with adjustment for age, family history, cigarette smoking, presence of cardiovascular disease (CVD) or diabetes, use of statins or acetylsalicylic acid, body mass index (BMI), alcohol intake, educational and physical activity levels. All analyses were done using SPSS 10.0 for Windows. Level of significance was set to $p < 0.05$.

RESULTS

Subject characteristics are in Table I. Overall use of antihypertensive drugs increased from 4.1% (95% CI 3.8–4.9) at age 40–45 years, to 19.1% (95% CI 17.9–20.3) at age 60 years and 35.8% (95% CI 34.2–37.4) at age 75 years. In subjects aged 40–45 years, 17.9% (95% CI 13.0–24.2) of those with CVD or diabetes used antihypertensive drugs, vs 3.6% (95% CI 3.2–4.1) of subjects without this history did so. This proportion increased to 50.5% (95% CI 45.9–55.1) of subjects aged 60 with CVD or diabetes and 15.1% (95% CI 14.0–16.3) of subjects without CVD or diabetes. In subjects aged 75, 56.7% (95% CI 53.4–59.8) of subjects with CVD or diabetes used antihypertensive drugs vs 27.6% (95% CI 25.9–29.5) of other subjects.

While the prevalence of blood pressure >140/90 mmHg was similar in subjects with CVD or diabetes and other subjects not taking antihypertensive drugs, treated subjects with CVD or diabetes had better blood pressure control than subjects without CVD or diabetes (Fig. 1). In all categories, women aged 40, 45 and 60 years had similar or better control of blood pressure compared with men. The prevalence of uncontrolled high blood pressure was 10.5% (95% CI 9.5–11.5) in women aged 40 and 45 years vs 21.2% (95% CI 19.7–22.7) in men, and 38.3% (95% CI 36.3–40.4) in women aged 60 vs 48.5% (95% CI 46.3–50.7) in men. At age 75 years, this tended to be reversed and the prevalence of uncontrolled high blood pressure was 64.9% (95% CI 62.3–67.1) in women vs 60.2 (95% CI 57.5–62.8) in men.

Characteristics of treated subjects with controlled and uncontrolled high blood pressure are shown in Table II. In multivariate logistic regression, high age in both genders, and in men, lack of treatment with statins, absence of CVD or diabetes and high BMI were associated with uncontrolled high blood pressure (Table III). In women, non-smoking was associated with uncontrolled high blood pressure (Table III). Subjects taking antihypertensive drugs and statins were more likely to be taking two or

Table II. *Demographic, medical and lifestyle characteristics of users of antihypertensive drugs with controlled and uncontrolled high blood pressure, the Oslo Health Study 2000–2001*

	Men		Women	
	Controlled	Uncontrolled	Controlled	Uncontrolled
CVD or diabetes, *n* (%)	165 (46.7)	236 (38.6)*	129 (31.2)	192 (27.4)
Education ≥13 years, *n* (%)	154 (45.2)	288 (49.1)	124 (30.8)	172 (25.3)*
Family history of heart attack or angina, *n* (%)	172 (54.1)	275 (50.8)	219 (59.5)	349 (56.5)
Current cigarette smoker, (%)	77 (22.0)	111 (18.3)	100 (24.4)	120 (17.3)**
Treated with statins, *n* (%)	165 (50.2)	193 (35.3)***	140 (37.9)	167 (27.4)**
Treated with acetylsalicylic acid, *n* (%)	115 (32.6)	181 (29.6)	98 (23.7)	160 (22.9)
BMI ≥25 kg/m^2, *n* (%)	268 (76.1)	486 (80.2)	279 (67.6)	484 (69.6)
Low physical activity, *n* (%)	64 (18.1)	102 (17.4)	75 (19.3)	136 (20.9)
Uses alcohol two or more times/week, *n* (%)	114 (33.0)	233 (38.8)	79 (19.6)	145 (21.4)

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.
CVD, cardiovascular disease; BMI, body mass index.

Table III. *Multivariable adjusted odds ratios (OR) and 95% confidence intervals (CI) for uncontrolled vs controlled high blood pressure in subjects using antihypertensive drugs (*n = *716 men and* n = *781 women with complete data for all of the variables), the Oslo Health Study 2000–2001*

	Men		Women	
	OR (95% CI)	*p*-value	OR (95% CI)	*p*-value
Age, years				
40–45	1.0 (referent)	1.0		
60	1.9 (1.1–3.0)	<0.05	2.7 (1.6–4.5)	<0.001
75	2.3 (1.4–3.8)	<0.01	5.6 (3.3–9.5)	<0.001
CVD or diabetes				
Absent	1.0	1.0		
Present	0.6 (0.4–0.9)	<0.05	0.7 (0.5–1.0)	ns
Educational level, years				
<13	1.0	1.0		
≥13	1.2 (0.9–1.7)	ns	0.8 (0.6–1.1)	ns
Family history of coronary heart disease				
Absent	1.0	1.0		
Present	1.0 (0.8–1.4)	ns	0.9 (0.6–1.2)	ns
Cigarette smoking				
Past or never	1.0	1.0		
Current	0.9 (0.6–1.3)	ns	0.7 (0.5–1.0)	<0.05
Treated with statins				
No	1.0	1.0		
Yes	0.6 (0.5–0.9)	0.01	0.7 (0.5–1.0)	ns
Treated with acetylsalicylic acid				
No	1.0	1.0		
Yes	1.1 (0.7–1.6)	ns	1.0 (0.7–1.5)	ns
BMI, kg/m^2				
<25	1.0	1.0		
≥25	1.5 (1.1–2.2)	<0.05	1.0 (0.7–1.4)	ns
Physical activity level				
Low	1.0	1.0		
Moderate/high	1.0 (0.6–1.5)	ns	1.2 (0.8–1.7)	ns
Use of alcohol				
0–once weekly	1.0	1.0		
≥2 times/week	1.2 (0.8–1.6)	ns	1.0 (0.7–1.5)	ns

CVD, cardiovascular disease; BMI, body mass index.; ns, not significant.

more antihypertensive drugs than were subjects taking antihypertensive drugs but not statins (51% vs 35%, $p < 0.001$). This difference was more pronounced in subjects with CVD or diabetes (53% vs 26%, $p < 0.001$) than in subjects without CVD or diabetes (32% vs 28%, $p = 0.26$).

DISCUSSION

Given the increasingly recognized importance of aggressive treatment of hypertension in patients with CVD or diabetes our finding that these subjects were more likely to have controlled high blood pressure than other subjects was encouraging. Better control of blood pressure was associated with a lower BMI in men, but not in women, while women smokers were more likely to have controlled high blood pressure than non-smokers. We lack data on patient compliance and other patient or physician factors that may interact with gender in determining blood pressure control.

Previous studies have likewise reported better control of high blood pressure in subjects with CVD than others [6], in part because drugs for hypertension are also used to treat manifestations of CVD. In contrast to our findings, in a number of previous studies patients with diabetes have had similar or worse control of hypertension when compared with patients without diabetes in the same population [14, 15]. However, using the single measurement of blood pressure available in this study, one-third to two-thirds of these subjects with CVD or diabetes still had a blood pressure level above the cut-off of 140/90 mmHg. This finding is similar to results of the European Euroaspire II study, in which about one-half of participants with CHD were found to have uncontrolled high

blood pressure [5]. In the case of diabetes, an even lower target blood pressure level of <130/80 mmHg has been recommended [2, 3]. Given the present findings, and results of a number of other studies [14, 15], this more stringent guideline may be difficult to reach.

Control of blood pressure was associated with the use of statins (statistically significant only in men), but not with the use of acetylsalicylic acid. This observation may be explained by the fact that subjects taking statins were more likely to take two or more drugs for hypertension compared with subjects not taking statins. Just over one-half of the subjects in the survey taking statins were treated with simvastatin, while about 30% took atorvastatin [16]. Preliminary data suggest that atorvastatin may reduce blood pressure levels [17]. A recently published population-based survey from the Netherlands, a country with a similar healthcare system to Norway, also reported that use of cholesterol-lowering drugs was associated with pharmacological treatment and with better control of high blood pressure [18].

We found, as in a number of other studies [19–21], that uncontrolled high blood pressure was most common among the elderly. This may be due to the difficulty of controlling blood pressure in the elderly or physicians' reluctance to do so. If the measurement and correction of high blood pressure were recommended primarily according to the absolute rather than the relative cardiovascular risk, then the elderly would be highly prioritized. On the other hand, a longer-term perspective prioritizes younger hypertensive patients with a high relative risk. Both approaches have been prioritized in European guidelines [22].

In addition to age, factors that influence hypertension control include socio-economic level, education and gender. In this population with easy access to nearly free medical care, reimbursement for antihypertensive drugs and frequent interactions with the healthcare systems, educational level was not a significant factor in control of high blood pressure. Some studies have shown that more pharmacologically treated men than women had uncontrolled high blood pressure [21]. We found this to be the case in the younger age groups but in subjects aged 75 years, more women tended to have uncontrolled high blood pressure than men.

Non-smoking women were more likely to have uncontrolled high blood pressure compared with smokers, independent of BMI. Although cigarette smoking acutely raises blood pressure and heart rate, tolerance to these effects develops over time. Blood pressure is either lower or similar in smokers compared with non-smokers [23]. Smoking cessation may increase blood pressure independent of gain in body weight [24]. Whether gender differences exist is uncertain. Both unchanged and increased blood pressure levels have previously been reported in prospective studies of men that quit smoking [24, 25]. In women, both smoking cessation and never or heavy smoking have been associated with hypertension. About 40% of non-smoking women in our study reported having quit smoking (data not shown). In a 9-year follow-up study of women taking part in a cardiovascular prevention programme in Malmö, Sweden, smoking cessation was associated with small differences in mean blood pressure, but with an increase in clinically significant hypertension [26]. Women smokers in the current study smoked a relatively low number of a mean of 12 cigarettes daily. In the Health Survey for England, women who smoked between one and nine cigarettes a day tended to have lower blood pressure levels than heavier smokers and never smokers [27].

The cut-off point for hypertension (>140/>90 mmHg) used in the present study is in accordance with the cut-off points recommended by international cardiovascular and hypertension guidelines [2, 3, 22] and is currently applied in most epidemiological and clinical studies in Europe and the USA [4, 5, 21]. Important barriers to achieving recommended levels of blood pressure are that guidelines may be controversial or not be disseminated in target countries. Most European countries appear not to set goals for control rates of hypertension in the population; in the USA this aim is 50% [28]. Norway does not have official guidelines for hypertension treatment. A group of Norwegian general practitioners have suggested [29] and subsequently updated [30] guidelines for blood pressure control, in part based on papers presented at a conference held in 1997 on treatment of mild hypertension [31]. The update suggested that only people with a blood pressure >170/100 mmHg or a level of >150/90 mmHg with a total cardiovascular risk of 20% during the next 10 years should receive pharmacological treatment [30]. On the other hand, specialists have urged more aggressive treatment in line with European guidelines (personal observation). These disagreements are not readily resolved. Disappointingly, a randomized trial that attempted to increase adherence to clinical guidelines found that clinical decision support systems did not improve the implementation of guidelines in general practice [32].

Our study has some limitations. Because blood pressure was measured on only one occasion, the prevalence of hypertension, requiring at least three separate measurements, could not be estimated and the proportion of adequately controlled high blood pressure was underestimated due to regression to the mean [33, 34]. Furthermore, drug use was based on self-report. However, previous studies have shown that the agreement between self-reported antihypertensive drug use and prescription records is high [35] and self-reported information on antihypertensive drug use seems to be reliable and accurate in regard to the number and type of

antihypertensive drugs used [36, 37]. The response rate to the survey was lower than expected, particularly in the younger age groups; on the other hand, almost all of those who attended the survey answered the questions on antihypertensive drug use. Analysis of non-attendees found that though they tended to be less educated than attendees, prevalence estimates of BMI, smoking and other health indicators were robust [38]. Moreover, educational level was not related to control of hypertension in this population.

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REFERENCES

1. Wolf-Maier K, Cooper RS, Banegas JR, *et al*. Hypertension prevalence and blood pressure levels in 6 European countries, Canada, and the United States. JAMA 2003; 289: 2363–9.
2. Guidelines Committee. 2003 European Society of Hypertension-European Society of Cardiology guidelines for the management of arterial hypertension. J Hypertens 2003; 21: 1011–53.
3. Chobanian A, Bakris GL, Black HR, *et al*. The seventh report of the Joint National committee on prevention, detection, evaluation, and treatment of high blood pressure. The JNC7 report. JAMA 2003; 289: 2560–72.
4. Wolf-Maier K, Cooper RS, Kramer H, *et al*. Hypertension treatment and control in five European countries, Canada, and the United States. Hypertension 2004; 43: 10–17.
5. EUROASPIRE II Study Group. Lifestyle and risk factor management and use of drug therapies in coronary patients from 15 countries. Principal results from EUROASPIRE II Euro Heart Survey program. Eur Heart J 2001; 22: 554–72.
6. Berlowitz DR, Ash AS, Hickey EC, *et al*. Inadequate management of blood pressure in a hypertensive population. N Engl J Med 1998; 339: 1957–63.
7. O'Connor PJ. Overcome clinical inertia to control systolic blood pressure. Arch Intern Med 2003; 263: 2677–8.
8. Hetlevik I, Holmen J, Krüger Ø, Holen A. Fifteen years with clinical guidelines in the treatment of hypertension – still discrepancies between intentions and practice. Scand J Primary Health Care 1997; 15: 134–40.
9. Oliveria SA, Lapuerta P, McCarthy BD, LåItalien GJ, Berlowitz DR, Asch SM. Physician-related barriers to the effective management of uncontrolled hypertension. Arch Intern Med 2002; 162: 413–20.
10. Waeber B. Treatment strategy to control blood pressure optimally in hypertensive patients. Blood Press 2001; 10: 62–73.
11. Waeber B, Brunner HR. The multifactorial nature of hypertension: the greatest challenge for its treatment? J Hypertens 2001; 19 Suppl 3: S9–16.
12. Per G. Lund-Larsen: Arven fra Statens skjermbildefotografering (SSF)/Statens helseundersøkelser (SHUS): En introduksjon til databanken. Nor J Epidemiol 2003; 13: 4–18. Full text available: http://www.medisin.ntnu.no/ism/nofe/norepid/2003(1)%2004-Innledning.pdf.
13. Vollset SE. Confidence intervals for a binomial proportion. Stat Med 1993; 12: 808–24.
14. Borzecki AM, Wong AT, Hickey EC, Ash AS, Berlowitz DR. Hypertension control. How well are we doing? Arch Intern Med 2003; 163: 2705–11.
15. Berlowitz DR, Ash AS, Hickey EC, *et al*. Hypertension management in diabetes: the need for more aggressive therapy. Diabetes Care 2003; 26: 355–9.
16. Tonstad S, Rosvold EO, Furu K, Skurtveit S. Undertreatment and overtreatment with statins: the Oslo Health Study 2000–2001. J Intern Med 2004; 255: 494–502.
17. Kanbay M, Yildirir A, Bozbas H, Ulus T, Demirtas K, Muderrisoglu H. Atorvastatin therapy helps to control blood pressure levels in hypertensive dyslipidemic patients. Atherosclerosis 2004; 5 Suppl 1: 126.
18. Schelleman H, Klungel OH, Kromhout D, de Boer A, Stricker BH, Verschuren W. Prevalence and determinants of undertreatment of hypertension in the Netherlands. J Human Hypertens 2004; 18: 317–24.
19. Hyman DJ, Pavlik VN. Characteristics of patients with uncontrolled hypertension in the United States. N Engl J Med 2001; 345: 479–86.
20. Barker WH, Mullooly JP, Linton KL. Trends in hypertension prevalence, treatment, and control in a well-defined older population. Hypertension 1998; 31: 552–9.
21. Hajjar I, Kotchen TA. Trends in prevalence, awareness, treatment, and control of hypertension in the United States, 1988–2000. JAMA 2003; 290: 199–206.
22. De Backer G, Ambrosioni E, Borch-Johnsen K, *et al*. Third joint task force of European and other societies on Cardiovascular Disease Prevention in Clinical Practice. European guidelines on cardiovascular disease prevention in clinical practice. Eur Heart J 2003; 24: 1601–10.
23. Omvik P. How smoking affects blood pressure. Blood Press 1996; 5: 71–7.
24. Lee DH, Ha MH, Kim JR, *et al*. Effects of smoking cessation on changes in blood pressure and incidence of hypertension: a 4-year follow-up study. Hypertension 2001; 37: 194–8.
25. Green MS, Harari G. A prospective study of effects of changes in smoking habits on blood counts, serum lipids and lipoproteins, body weight and blood pressure in occupationally active men. The Israeli Cordi study. J Cli Epidemiol 1995; 9: 1159–66.
26. Janzon E, Hedblad B, Berglund G, Engström G. Changes in blood pressure and body weight following smoking cessation in women. J Intern Med 2004; 255: 266–72.
27. Primatesta P, Falschetti E, Gupta S, Marmot MG, Poulter NR. Association between smoking and blood pressure. Evidence from the Health Survey for England. Hypertension 2001; 37: 187–93.
28. US Department of Health and Human Services. Healthy People 2010: Understanding and improving health, 2nd edition. Washington, DC: US Government Printing Office, 2000: 12–22.
29. Holmen J, editor Høyt blodtrykk. NSAMs handlingsprogram. Utredningsrapport nr. U3–1993. Seksjon for helsetjenesteforskning. Samfunnsmedisinsk forskningssenter. Verdal: Statens Institutt for Folkehelse, 1993.
30. Meland E, Ellekjær H, Gjelsvik B, Kimsås A, Holmen J, Hetlevik I. Pharmacological prevention of cardiovascular disease in general practice. Tidsskr Nor Lægeforen 2000; 120: 2643–7.

31. Petersen H, Næss A-C, Dalsegg A, *et al* Behandling av mild hypertensjon. Konsensuskonferanse. Oslo: Norges forskningsråd. Komiteen for medisinsk teknologivurdering, 1997.
32. Hetlevik I, Holmen J, Krüger Ø, Kristensen P, Iversen H. Implementing clinical guidelines in the treatment of hypertension in general practice. Blood Press 1998; 7: 1–7.
33. MacMahon S, Peto R, Cutler J, *et al*. Blood pressure, stroke and coronary heart disease part I. Prolonged differences in blood pressure: prospective observational studies corrected for regression dilution bias. Lancet 1990; 335: 765–74.
34. Birkett NJ, Donner AP, Maynard MD. Assessing hypertension control in the community: the need for follow-up measurements to ensure clinical relevance. Can Med Assoc J 1987; 136: 595–600.
35. Furu K, Skurtveit S, Rosvold EO. Drug use questions in Norwegian health surveys – response rate and agreement between specific and open-ended questions. Nor J Epidemiol 2003; 13: 147–54.
36. Enlund H, Tuomilehto J, Turakka H. Patient report validated against prescription records for measuring use of and compliance with antihypertensive drugs. Acta Med Scand 1981; 209: 271–5.
37. Klungel OH, de Boer A, Paes AHP, Herings RMC, Seidell JC, Bakker A. Agreement between self-reported antihypertensive drug use and pharmacy records in a population-based study in The Netherlands. Pharmacy World & Science 1999; 21: 217–20.
38. Søgaard AJ, Selmer R, Bjertness E, Thelle D. The Oslo Health Study. The impact of self-selection in a large, population-based survey. Int J Equity Health 2004; 3: 3Online: http://www.equityhealthj.com/content/3/1/3.

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