Prevalence, control and awareness of high blood pressure among Canadian adults

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Objective: To estimate the prevalence and distribution of elevated blood pressure (BP) among Canadian adults and to determine the level of control, treatment, awareness and prevalence of other risk factors among adults with high BP.
Design: Population-based cross-sectional surveys.
Setting: Nine Canadian provinces, from 1986 to 1990.
Participants: A probability sample of 26 293 men and women aged 18 to 74 years was selected from the health insurance registers in each province. For 20 582 subjects, BP was measured at least twice. Nurses administered a standard questionnaire and recorded two BP measurements using a standardized technique. Two further BP readings, anthropometric measurements and a blood specimen for lipid analysis were obtained from those subjects who attended a clinic.
Outcome measures: Mean values of systolic and diastolic BP, prevalence of elevated BP using different criteria, and prevalence of smoking, elevated blood cholesterol, body mass index, physical activity and presence of diabetes by high BP status are reported.
Main results: Sixteen percent of men and 13% of women had diastolic BP of 90 mm Hg or greater or were on treatment (or both). About 26% of these subjects were unaware of their hypertension, 42% were being treated and their condition controlled, 16% were treated and not controlled, and 16% were neither treated nor controlled. Use of non-pharmacologic treatment of high BP with or without medication was low (22%). Hypertensive subjects showed a higher prevalence of elevated total cholesterol, high body mass index, diabetes and sedentary lifestyle than normotensive subjects. Most people with elevated BP were in the 90 to 95 mm Hg range for diastolic pressure and 140 to 160 mm Hg range for systolic pressure. Prevalence of high isolated systolic BP sharply increased in men (40%) and women (49%) 65 to 74 years old.
Conclusions: The relatively low level of control of elevated BP calls for population and individual strategies, stressing a non-pharmacologic approach and addressing isolated systolic hypertension in the elderly.

High blood pressure (BP) is a major risk factor for cardiovascular disease (CVD). There is overwhelming evidence that elevated systolic or diastolic BP, or both, increases the probability of ischemic heart disease, stroke, atherosclerosis and overall mortality.[1-20] Treatment and control of high BP reduce the risk of stroke and possibly the risk of ischemic heart disease.[21-24]

Non-pharmacologic management of high BP emphasizes modification of the major factors determining risk: obesity, alcohol and nutrition,[25,26] including a lower sodium diet.[27]

This report documents the prevalence of high BP, its distribution, level of control, treatment and awareness among 20 582 people from nine provinces who participated in the provincial heart health

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surveys. Prevalence of the other major risk factors for CVD by level of high BP are also presented.

Methods

Population

Details on selection of the survey population are described in the methods paper of this supplement (pages 1969–1974). Briefly, nine provinces were involved in a federal–provincial initiative between 1986 and 1990. The target population for the survey was people aged 18 to 74 years, excluding those living on Indian reserves, institutions (e.g., prisons, hospitals) and military camps.

Trained survey nurses administered a questionnaire during a home visit at which two BP measurements were taken. At a clinic visit less than 2 weeks later, fasting blood samples, two additional BP readings and anthropometric measurements were taken. Blood samples and completed questionnaires were sent to the provincial coordinator who forwarded blood samples to a standardized lipid laboratory in Toronto within the next 24 hours.

Blood pressure

Standardization for identification of the Korotkoff sounds was carried out following a manual developed for the Hypertension Detection and Follow-up Program, School of Public Health, University of Texas. Standard mercury sphygmomanometers, 15-inch stethoscopes and appropriately sized cuffs were used.

The subject rested quietly for a minimum of 5 minutes and had been asked not to eat or smoke for at least 30 minutes before the measurement. The participant's right arm was held at the level of the heart. The maximum inflation level was determined before actual measurement of blood pressure. The first and fifth Korotkoff sounds were recorded for the systolic and diastolic pressures, respectively. For sounds that continued to 0 mm Hg, the fourth Korotkoff sound was used. The pulse was also measured.

Four blood pressure readings were taken: one each at the beginning and end of the home interview and at the beginning and end of the clinic visit. The blood pressure values presented in this report are based on the mean of the measurements. For participants who did not come to the clinic, the values used are the mean of the two measurements taken during the home interview.

All participants were informed of the results of their BP measurements. Those with diastolic BP above 90 mm Hg were advised to see a doctor according to the Referral Guidelines of the Canadian Hypertension Society and of the Canadian Coalition for High Blood Pressure.[28,29]

Estimates presented in this report are weighted. Age-standardized estimates are based on the age–sex distribution of the 1986 Canadian population. Unless specified, all estimates are based on cell populations greater than 20. Some tabulations are not standardized to reflect the mean or prevalence in the population as an estimate of burden of the condition in the population under study.

Results

Mean systolic and diastolic BP and standard deviations are given, for the people in the sample who had a BP measurement, in Table 1 by age and sex. The difference in distribution between some age groups is due to the initial age grouping and oversampling in the younger age groups.

Systolic BP increased with age (Table 1); the increase was gradual among men, from 120.5 mm Hg in the 18–24 age group to almost 140 mm Hg in the 65–74 age group. In the younger age groups, women had a lower systolic BP than men by almost 10 mm Hg. Mean systolic BP of women increased sharply in the 45–54 age group, to reach a slightly higher level than men in the 65–74 age group (140.7 and 139.6 mm Hg, respectively).

Mean diastolic BP also increased with age in men, from 73.3 mm Hg in the youngest age group to peak at 82.0 mm Hg in the 55–64 age group and declined to 79.7 in the 65–74 age group. Mean diastolic BP was lower in women than in men for each age group. There was a sudden increase in mean diastolic BP between the 35–44 and 45–54 age groups of women (73.3 to 77.0 mm Hg). Like men, the peak mean diastolic BP of women occurred in the 55–64 age group with a decline thereafter.

The percentage distribution of individuals by systolic and diastolic BP is presented in Tables 2 and 3. The data do not take into account the presence of treatment. However, the distribution of actual measurements defines the proportion of the population at risk due to elevated BP.

Prevalence figures for systolic BP (Table 2) reflect some of the characteristics of the mean values. The prevalence of systolic BP above 130 mm Hg in men increased gradually with age: 47% of men in the 65–74 age group had a BP of 140 mm Hg or greater, 14% were at a BP of 160 mm Hg or greater and 33% were in what is considered the mild hypertension range (140 to 159 mm Hg). Prevalence of BP under 130 mm Hg decreased with age. Overall, 15% of men had a systolic BP of 140 mm Hg or greater, 12% were in the 140 to 159 mm Hg range and only 3% had a BP of 160 or greater.

Among women, prevalence of high systolic BP

(Table 2) increased with age starting at the 120 to 129 mm Hg level, but more clearly in the higher ranges, with a sharp increase between the 35–44 and the 55–64 age groups. In the 65–74 age group, 47% of women had a systolic BP of 140 mm Hg or greater (the same as in men), but the prevalence of systolic BP of 160 mm Hg or greater was slightly higher in women (15% v. 14%). Overall, 11% of women had a systolic BP of 140 mm Hg or greater, 8% were in the 140 to 159 mm Hg range and 3% had a systolic BP of 160 mm Hg or greater.

Of all participants, 14% had a systolic BP of 140 mm Hg or greater, 11% in the 140 to 159 mm Hg range and 3% at the 160 mm Hg level or greater.

For both men and women, prevalence of elevated diastolic BP (Table 3) increased with age, starting

Table 1: Mean systolic and diastolic blood pressures* by sex and age

Sex; age	No. of subjects	Mean blood pressure (and SD†), mm Hg	
		Systolic	Diastolic
Men			
18–24	1 700	120.5 (10.2)	73.3 (8.4)
25–34	3 429	121.6 (10.9)	76.7 (8.4)
35–44	1 402	122.5 (11.2)	80.0 (8.7)
45–54	911	127.5 (14.0)	81.9 (9.3)
55–64	904	136.2 (17.7)	82.0 (9.6)
65–74	1 764	139.6 (18.6)	79.7 (9.5)
All	10 110	126.0 (14.7)	78.7 (9.3)
Women			
18–24	1 753	110.8 (9.5)	68.4 (7.9)
25–34	3 667	110.3 (10.1)	70.1 (8.1)
35–44	1 443	113.6 (11.3)	73.3 (8.4)
45–54	1 004	120.5 (15.3)	77.0 (9.6)
55–64	906	131.7 (17.6)	79.0 (8.9)
65–74	1 699	140.7 (18.6)	77.8 (9.0)
All	10 472	118.7 (16.9)	73.6 (9.4)
Total	20 582	122.3 (16.3)	76.1 (9.7)

*Based on the mean of four blood pressure readings during a home interview and a clinic examination (n = 18 059) or two readings for those who did not attend the clinic (n = 2523).
†SD = standard deviation.

Table 2: Distribution of subjects by systolic blood pressure according to age and sex

Sex; age	Systolic blood pressure, mm Hg; % of subjects					
	< 120	120–129	130–139	140–149	150–159	≥ 160
Men						
18–24	49	34	14	3	0	0
25–34	45	33	16	5	1	0
35–44	43	34	16	5	2	0
45–54	32	34	18	9	4	3
55–64	18	24	18	18	12	11
65–74	13	18	22	21	12	14
All	37	31	17	8	4	3
Women						
18–24	84	12	3	0	0	0
25–34	84	12	3	1	0	0
35–44	72	18	7	2	0	0
45–54	55	22	11	7	3	2
55–64	24	23	24	14	7	8
65–74	11	19	22	17	15	15
All	61	17	10	5	3	3
Total	49	24	13	7	4	3

at the 80 mm Hg level. Few men or women in the 18–24 age group had a BP of 90 mm Hg or greater (1% or fewer); however, in the 65–74 age group, these rates increased to 13% for men and 10% for women. Overall, 11% of the men and 6% of the women (8% for all participants) had a diastolic BP at or above 90 mm Hg.

The prevalence of high BP was examined using different categories (i.e., systolic BP ≥ 140 mm Hg or on medication; diastolic BP ≥ 90 mm Hg or on medication; and elevated diastolic BP, elevated systolic BP or on treatment) (Table 4). Prevalence of high BP increased with age for all of these categories. In men, prevalence increased from 4%, 2% and 5% for the three categories of 18 to 24 year olds to 52%, 27% and 52% for 65 to 74 year olds. Among women, the increase was greater: from about 1% of the 18 to 24 year olds in each category to 58%, 38% and 58% of 65 to 74 year olds. While in men prevalence in the "either" category increased gradually with age, in women it tripled between the 35–44 age group and the 45–54 age group (7% to 22%), and almost doubled between the latter group and the 55–64 age group (to 43%). Overall, 20% of participants in the 18–74 age group had an elevated systolic or diastolic BP, or both; 18% had elevated systolic BP and 15% had elevated diastolic BP.

Prevalence of isolated high systolic BP was low in the younger age groups for both men and women (Table 5); 3% and fewer than 1%, respectively, had systolic BP at or above 140 mm Hg and diastolic BP below 90 mm Hg. There was a sudden increase in prevalence, from 5% for the 45–54 age group to 23% of men and 20% of women in the 55–64 age group and reaching 34% and 39%, respectively, in the 65–74 age group. A similar pattern was noted for isolated high systolic BP at or above 160 mm Hg. Although prevalence in both men and women under age 55 was less than 1%, it increased to 6% of men and 10% of women in the 65–74 age group.

Table 3: Distribution of subjects by diastolic blood pressure according to sex and age

	Diastolic blood pressure, mm Hg; % of subjects					
	< 80	80–84	85–89	90–94	95–99	> 100
Men						
18–24	77	15	6	1	0	0
25–34	65	17	11	5	2	0
35–44	49	25	12	9	4	1
45–54	43	22	15	9	7	3
55–64	40	24	17	9	5	5
65–74	51	20	15	6	4	3
All	56	20	12	6	3	2
Women						
18–24	92	5	2	0	0	0
25–34	88	8	3	1	0	0
35–44	79	12	6	3	0	0
45–54	63	16	10	7	3	1
55–64	55	20	14	7	2	2
65–74	60	20	10	6	2	2
All	75	13	7	4	1	1
Total	66	16	10	5	2	1

Table 4: Prevalence of high blood pressure* by sex and age

	Men			Women			Total		
Age; yr	Systolic	Diastolic	Either	Systolic	Diastolic	Either	Systolic	Diastolic	Either
18–24	4	2	5	1	1	1	3	2	3
25–34	8	9	12	3	3	4	5	6	8
35–44	10	15	18	5	6	7	7	11	13
45–54	21	25	28	20	19	22	20	22	25
55–64	49	33	50	42	32	43	45	32	46
65–74	52	27	52	58	38	58	55	33	56
All	19	16	23	17	13	18	18	15	20

*The three categories for each group were defined as: mean systolic blood pressure ≥ 140 mm Hg or on treatment (pharmacologic or non-pharmacologic); mean diastolic blood pressure ≥ 90 mm Hg or on treatment; and either high systolic or diastolic blood pressure (as above) or on treatment.

The level of treatment, control and awareness among those with high BP was tabulated by sex for three age groups (Table 6). These figures are from people who were told that they had high BP or who had a diastolic BP at or over 90 mm Hg. The level of awareness, treatment and control increased with age in both sexes. However, these levels were higher for women than men, especially in the younger age groups. About 57% of men and 14% of women 18 to 34 years old were not aware that they had high BP. Of those 55 to 74 years old, 19% of men and 9% of women were still unaware of their high BP status. Overall, 34% of men and 15% of women were unaware of their condition.

The "controlled" status was defined as having a mean diastolic BP less than 90 mm Hg. Although more than half of women were treated and controlled (59%), with a slightly lower prevalence between ages 35 and 54 (41%), only 28% of men were in this category, 16% in the 18–34 group and up to 46% in the oldest group. Nevertheless, based on the number treated, there was no difference in percent-

Table 5: Prevalence of high isolated systolic blood pressure* by sex and age

Sex; age	Isolated systolic blood pressure, mm Hg; % of subjects	
	≥ 140	≥ 160
Men		
18–24	3	0
25–34	4	0
35–44	2	0
45–54	5	0
55–64	23	3
65–74	34	6
All	9	1
Women		
18–24	0	0
25–34	0	0
35–44	1	0
45–54	5	0
55–64	20	5
65–74	39	10
All	8	2
Total	8	1

*High systolic blood pressure, but mean diastolic blood pressure < 90 mm Hg.

Table 6: Awareness, treatment and control status of participants with high blood pressure by sex and age*

Sex; age, yr	No. of subjects	Aware			Unaware
		Treated, controlled	Treated, not controlled	Not treated, not controlled	
Men					
18–34	422	16	6	21	57
35–54	533	15	18	26	40
55–74	909	46	23	13	19
All	1864	28	18	20	34
Women					
18–34	160	53	13	20	14
35–54	353	41	12	20	27
55–74	1051	69	15	6	9
All	1564	59	14	11	15
Total	3428	42	16	16	26

*Sample includes participants who had been told that they have high blood pressure and those who had not been told but whose mean diastolic blood pressure was ≥ 90 mm Hg. Those with mean diastolic blood pressure < 90 mm Hg and not on treatment, but who had been told that they have high blood pressure were excluded. Awareness implies having been told of high blood pressure. Treatment includes pharmacologic or non-pharmacologic management. Control implies mean diastolic blood pressure < 90 mm Hg.

age controlled by age among women (about 80%). In men, although the percentage of those with controlled BP among those being treated was above 60%, in the 35–54 age group fewer than 50% were controlled.

The prevalence of people aware but not treated or controlled decreased from about 20% in the 18–34 age group to 13% of men and 6% of women in the 55–74 age group. Almost twice as many men as women (20% v. 11%) and about 16% total are not treated or controlled.

The distribution of people who had been told that they had high BP is presented by treatment in Table 7 according to sex and for three age groups. The prevalence of men and women who were not following any treatment decreased with age from 86% of men and 89% of women in the youngest group to 38% of men and 32% of women in the oldest group. At the same time, the prevalence of individuals who reported following a pharmacologic or non-pharmacologic treatment increased with age; about 37% of men and women in the oldest groups were taking medication only, and 18% of men and 24% of women in that group were following both a pharmacologic and non-pharmacologic treatment. The prevalence of non-pharmacologic management is low in all sex and age groups (5% to 12%) in this study.

Overall, a large majority of people who were told that they had high BP were not following any treatment (59%). More people received a pharmacologic treatment alone than a combination of drugs and non-pharmacologic treatment (19% v. 14%) or a non-pharmacologic approach alone (8%).

The age-standardized prevalence of other CVD risk factors by hypertension status is presented in Table 8. With the exception of smoking, all prevalence figures were higher in the hypertensive than in the normotensive group. The greatest differences were for body mass index (BMI), especially among women, and for blood cholesterol. There were about 4% fewer male smokers and about 2% fewer female smokers in the hypertensive than in the normoten-

Table 8: Age-standardized* prevalence of risk factors for cardiovascular disease by high blood pressure status and sex†

	Blood pressure status; § % of subjects	
Risk factor‡	Normal	High
Men		
Smoking	31 (8250)	27 (1864)
Total cholesterol level, mmol/L		
≥ 5.2	45 (6781)	57 (1567)
≥ 6.2	17 (6781)	21 (1567)
Body mass index		
≥ 25	51 (7148)	74 (1648)
≥ 27	31 (7148)	52 (1648)
Sedentary	37 (8245)	42 (1859)
Diabetes	4 (7413)	6 (1684)
Women		
Smoking	29 (8908)	27 (1564)
Total cholesterol level, mmol/L		
≥ 5.2	42 (7293)	50 (1278)
≥ 6.2	15 (7293)	18 (1278)
Body mass index		
≥ 25	36 (7721)	62 (1341)
≥ 27	24 (7721)	49 (1341)
Sedentary	34 (8901)	39 (1562)
Diabetes	4 (7992)	7 (1389)

*Age standardized to the 1986 Canadian population.
†Figures in parentheses are sample sizes.
‡Smoking = one or more cigarettes every day; sedentary = leisure-time physical activity less than once a week during the last month; diabetes = self-reported.
§Normal blood pressure = mean diastolic pressure of < 90 mm Hg and not on treatment; high blood pressure = mean diastolic of ≥ 90 mm Hg or on treatment (pharmacologic or non-pharmacologic).

Table 7: Distribution of subjects who were aware of their high blood pressure by treatment, sex and age

		Treatment; % of subjects			
Sex; age, yr	No. of subjects	None	Drugs only	Drugs and other*	No drugs*
Men					
18–34	563	86	3	2	9
35–54	532	68	9	11	12
55–74	952	38	37	18	6
All	2047	60	19	12	9
Women					
18–34	848	89	1	2	7
35–54	606	70	10	12	8
55–74	1241	32	38	24	5
All	2695	58	20	15	7
Total	4742	59	19	14	8

*Non-pharmacologic management = low-sodium diet, weight control program or both.

sive group. About 27% of men and women with high BP smoked regularly.

A greater proportion of men (57%) than women (50%) with high BP also had elevated blood cholesterol levels (5.2 mmol/L or greater); 21% of men and 18% of women also had a blood cholesterol level at or above 6.2 mmol/L. Similarly, more men (74%) than women (62%) with high BP also had a BMI of 25 or over; 52% and 49% had a BMI of 27 or over. On the other hand, the prevalence of sedentary lifestyle and diabetes was similar in men and women with hypertension.

Discussion

Other Canadian[8-10,30] and international population studies[11-16,31-34] provide some degree of comparison with this survey. However, studies such as the WHO-MONICA Project,[32,33] the National Health and Nutrition Examination Survey,[20] the Australian heart health survey[31] and the Canadian Blood Pressure Survey[30] did not use the same methods. Different time periods, techniques, age groups, number of measurements taken, different phases of the Korotkoff sounds and different cut-off points for prevalence estimates have been used. Therefore, comparisons between surveys, especially comparison of prevalence estimates, must be interpreted with caution.

Despite these differences, similar trends by age and sex have been observed in some of these surveys and the current study. For example, the Minnesota Heart Survey[35] reports lower mean systolic and diastolic BPs for each age and sex group, but similar prevalence of high BP using a comparable, although not identical, definition.

Recent studies have emphasized the benefits of treating elevated BP. In his reanalysis of several prospective studies, MacMahon[23] states that even small reductions in diastolic BP could be associated with fewer stroke and coronary heart disease events.

Most people with elevated BP are in the mild to moderate hypertension groups and in the older groups where isolated systolic hypertension (140 mm Hg or over) affects more than a third of men and women (Table 5). The benefits of treating the so-called mild to moderate levels of high BP using either pharmacologic[36] or non-pharmacologic treatment[37,38] have been stressed by several authors.

Recent results from the Systolic Hypertension in the Elderly Program[39-41] have clearly demonstrated the benefits of treating isolated systolic hypertension in the elderly. The previous lack of evidence of the benefit of treating isolated systolic hypertension led the Canadian 1986 Consensus Conference on Hypertension in the Elderly to refrain from recommending treatment for BP below 180 mm Hg.[42]

Although prevalence of isolated systolic hypertension was below 5% in younger groups, it affected a significant percentage of men and women (34% and 39%, respectively) in the 65–74 age group using the cut-off point of 140 mm Hg. Epidemiologic studies have reiterated that increase in risk is progressive with increase in either systolic or diastolic BP, without evidence of a threshold, even among older subjects. Although some concern has been raised by the relation of low diastolic BP to increase in mortality in older age groups,[43] this rise in mortality may be explained by the presence of other conditions.[44] Hypertension in the younger groups was rare, but a relatively high proportion of hypertensive people in the 18–34 age group were still not aware of their condition (Table 6).

Although awareness and treatment increase with age, there was still a sizable proportion of treated hypertensive people whose BP was not controlled. However, this group of "treated and not controlled" may include individuals in whom a significant level of control had been achieved but who still had a diastolic BP at or above 90 mm Hg.

According to participants in the older group, non-pharmacologic treatment was either not applied or not followed. Drugs were the only reported means of treatment in 30% of hypertensive subjects, and this proportion increased with age. Given the recent consensus on non-pharmacologic treatment of high BP[25] and some of the side effects of drugs, especially among older patients, there should be greater emphasis on non-pharmacologic management of high BP, alone or in combination with drugs.[45-47] This is even more important as a high prevalence of elevated systolic or diastolic BP is seen in the mild to moderate ranges.

Only 30% of hypertensive subjects had no other major risk factor (see paper on multiple risk factors, pages 2021–2029). This clearly means that other risk factors should be taken into consideration when treating a person with hypertension. Synergistic effects of the risk factors on the risk of CHD and stroke are frequently emphasized in the literature,[48-51] even at moderate elevations.[51] Even though there were slightly fewer smokers among hypertensive subjects than among normotensive subjects, about 27% of those with high BP carried an additional risk by smoking.

This study confirms the high prevalence of overweight people among those with high BP (74% of men and 50% of women). This is not surprising as obesity is a major risk factor for hypertension, and overweight people with hypertension are not at less risk of CVD than lean people with hypertension.[52,53]

The high prevalence of elevated blood cholesterol and sedentary lifestyle is also to be expected among hypertensive subjects given their association with obesity (see paper on obesity, pages 2009–

2019). The prevalence of reported diabetes in hypertensive subjects was almost double that in subjects with low BP, increasing their risk several fold.[54-56] The recent Canadian Hypertension Society Consensus Conference on Hypertension and Diabetes has outlined the importance of managing hypertension among diabetics, particularly its ability to slow the progression of renal involvement.[57]

Despite the extent of this study, some limitations have been noted. The population of Ontario is not included because the Ontario survey is still under way; its conclusion will allow a complete picture of high BP in Canada.

Relatively small numbers of subjects have been noted in some age-sex categories, requiring regrouping to allow more stable rates (Tables 6 and 7).

The cut-off points used in this study for defining high BP may differ from those used in other studies or for establishing recommendations. However, they represent the most current categories used to define high BP and to estimate the proportion of the different age and sex groups at increased risk of CVD from an epidemiologic perspective.

Despite important progress in the detection and management of high BP in Canada, several issues have been identified by this survey. The high prevalence of high BP in older groups, especially women, requires special attention in terms of treatment and control. Guidelines on the management of high BP must be updated given the proven benefits of treating isolated high systolic BP in the elderly. Dissemination and adoption of these guidelines by physicians should also be encouraged.

Too many people with high BP are unaware of or are not using non-pharmacologic treatment. Promoting non-pharmacologic treatment and addressing the concomitant factors requires a collaborative approach that goes beyond the treatment of high BP into such areas as nutrition counselling, supporting increased physical activity and increasing access to healthy choices.

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