



Trends in the prevalence and treatment of hypertension in Halifax County from 1985 to 1995

Hermann K. Wolf,* PhD; Pantelis Andreou,† MSc;
Iqbal R. Bata,‡ LRCPS; Donna G. Comeau,† BSc;
Ronald D. Gregor,‡ MD; George Kephart,† PhD;
David R. MacLean,† MD, MHSc;
Ingrid Sketris,§ PharmD MPA (HSA)

Abstract

Background: The objective of this study was to document changes in the prevalence and treatment of hypertension in Halifax County from 1985 to 1995 in an effort to observe, at the population level, the consequences of the availability of new antihypertensive medications.

Methods: The study population comprised a random sample of Halifax County residents, aged 25–64 years, who responded to the 1985 and 1995 surveys of the Halifax County MONICA Project and residents who responded to the Nova Scotia Health Survey conducted in 1995. Data from the two 1995 surveys were pooled. Information on hypertension awareness and use of medication were obtained through questionnaires, and blood pressure was measured according to a standard protocol, using phase I and V of Korotkoff sounds as respective markers for systolic and diastolic pressures. Uncontrolled hypertension was defined as a systolic pressure of 140 mm Hg or greater and a diastolic pressure of 90 mm Hg or greater. Changes in the prevalence of hypertension, prescribing trends and medication costs were examined, and the association between the type of antihypertensive treatment and characteristics of the respondents with self-reported hypertension was investigated by multivariate logistic regression.

Results: Of the 917 people interviewed in 1985 and the 1338 in 1995, 274 (29.9%) and 356 (26.6%), respectively, reported a history of hypertension. When age was controlled for, the proportion of respondents reporting hypertension did not differ between survey years or between men and women. The proportion of treated respondents who had uncontrolled hypertension increased between 1985 and 1995, from 32.6% to 57.4% among men and from 38.0% to 42.6% among women. An increase was seen in the use of calcium-channel blockers (from 2.1% to 19.7%) and angiotensin-converting-enzyme inhibitors (from 5.2% to 25.4%); the proportion of patients receiving combination therapy or diuretics decreased (from 39.6% to 15.6% and from 31.3% to 17.2% respectively). These changes were associated with an increase in the average daily cost of medication from \$0.48 to \$0.85 per patient.

Interpretation: The shift to new antihypertensive drugs was not associated with improved blood pressure control, but it was associated with an increase in average medication costs per patient. Uncontrolled hypertension remains a public health problem.

Controlled clinical trials over the last 40 years have proven many new antihypertensive medications to be effective for the treatment of hypertension. More recently, nonpharmacological agents have been added to the list of treatment options.¹ With increasing awareness of the benefits associated with treating hypertension, one would expect that the prevalence of hypertension as a public health problem would be significantly reduced. Indeed, many studies have con-

Evidence

Études

From the Departments of
*Physiology and Biophysics,
†Community Health and
Epidemiology, and ‡Medicine
and §the College of
Pharmacy, Dalhousie
University, Halifax, NS

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‡ See related article page 713



firmed a gradual decline in the mean blood pressure of population samples and a reduction in the prevalence of hypertension.²⁻⁵ The Minnesota Heart Survey⁶ found a general decline in blood pressure between 1980 and 1987 in all but systolic pressure among men, which remained constant; and blood pressure in Finland decreased between 1982 and 1997 for all but systolic pressure among men in one study area.⁷ However, some studies have reported evidence to the contrary. German investigators found an increase in systolic pressure between 1984 and 1990 among women,⁸ and the systolic pressure among men and women in Halifax County increased between 1985 and 1995.⁹

Physicians have taken full advantage of the increase in the different antihypertensive medications available.¹⁰⁻¹³ Utilization of the newer drugs has increased, despite the lack of evidence from long-term clinical trials of their effects on cardiovascular disease outcomes. Moreover, with the current prevalence of hypertension and the necessity for long-term therapy, the cost of antihypertensive medication for blood pressure control¹⁴ may have an impact on treatment trends.

We used the data from the Halifax County MONICA (*Monitoring of Trends and Determinants in Cardiovascular Disease*) Project,⁹ coordinated by the World Health Organization, and the Nova Scotia Health Survey 1995 to investigate changes in the prevalence of hypertension, in prescribing trends and in the costs of antihypertensive medications from 1985 to 1995 in Halifax County.

Methods

For the MONICA Project 2 independent random samples of residents of Halifax County were surveyed: 1 in 1985 (age range 25-64 years) and 1 in 1995 (age range 25-74 years). The Nova Scotia Health Survey 1995 surveyed the same population as the MONICA project in 1995. We previously published details on the survey design, recruitment process, response rates and blood pressure recording method for the MONICA Project^{9,15} and the Nova Scotia Health Survey.¹⁶ The data from the two 1995 surveys were pooled. To allow for this, the portions of the respective surveys dealing with hypertension were standardized, and identical sampling frames and procedures were used. Respondent awareness of hypertension and treatment status were determined by a series of questions, the first of which was "Were you ever told by a doctor, nurse or some other health care professional that you had high blood pressure?" A positive response led to further unprompted questions regarding initial treatment and current treatment status; responses were categorized into pharmacological treatment, nonpharmacological treatment (e.g., weight reduction, salt restriction) or no treatment at all.

Since the survey data provided only 1 set of blood pressure values, we could not independently classify respondents with hypertension. Therefore, we defined respondents as hypertensive if they had previously been told by a health care professional that they had high blood pressure. Medication status was not factored into this definition. Participants who were not told that they had hypertension but who were taking medication to lower blood pressure were not classified as hypertensives. Also, those

who claimed hypertension as an indication for one of their drugs that had no antihypertensive action were not classified as treated hypertensives.

Other health problems and prescription and nonprescription medications that respondents were taking at the time of the survey were inquired about in the health history questionnaire; dosage, frequency and indication for all medications were recorded. If medication information was collected during a home visit (some of the MONICA data and all of the Nova Scotia Health Survey data), medication bottles were inspected; otherwise data were based on the respondents' recall.

Medication was coded using the World Health Organization's *Anatomical Therapeutic Chemical Classification Index*,¹⁷ which also lists defined daily doses for individual medications. A defined daily dose is "the assumed average maintenance dose per day for a drug used on its main indication in adults."¹⁸ For combined preparations we consulted the *Compendium of Pharmaceuticals and Specialties*¹⁹ and based the defined daily dose on the recommended maintenance dose.

To estimate the cost of drug treatment we assumed that antihypertensive agents were prescribed in defined daily doses. We tested the validity of this assumption by correlating the self-reported dosages with the defined daily doses for the 1995 data, where only 5% of the data was missing. The correlation coefficient was 0.87; defined daily doses were, on average, 12% lower than the self-reported dosages. The cost per defined daily dose for each antihypertensive drug was based on the least expensive unit price (suggested retail price excluding dispensing fee) listed in the 1995 *Atlantic Pharmaceutical Services Incorporated Pricing Guide* and its appendix.^{20,21} The cost for combined drug treatments was the sum of the costs of the defined daily doses for all of the prescribed drugs.

The blood pressure of respondents in the MONICA Project was recorded using a random zero device.⁹ A standard mercury sphygmomanometer was used for respondents of the Nova Scotia Health Survey. All survey personnel received identical training for recording blood pressure. Systolic and diastolic blood pressures were defined as phase I and phase V of Korotkoff sounds, respectively. The average value of the first 2 readings, taken at least 10 minutes apart with the person seated, was used as the casual blood pressure measurement. Elevated blood pressure was defined as an average systolic pressure of 140 mm Hg or greater or an average diastolic pressure of 90 mm Hg or greater.

Logistic regression usually included age, sex and survey year as covariates. The small sample and lack of availability of data precluded controlling for other possible confounding variables. Interaction terms were included, as required by goodness-of-fit.

Both the MONICA Project and the Nova Scotia Health Survey were approved by the Dalhousie University Faculty of Medicine Ethics Review Committee.

Results

Of the residents contacted in the 1985 and 1995 phases of the MONICA project 917 (67%) and 730 (69%), respectively, agreed to participate; for the Nova Scotia Health Survey 608 (72%) agreed to be interviewed. We excluded from the blood pressure analysis 98 blood pressure measurements (4.3%) that were taken by 2 nurses; the probability of having 0 as a terminal digit should be 20%,²² but 87% and 40% of the nurses' respective blood pressure



measurements had 0 as the last digit. The feasibility of pooling the 1995 MONICA and Nova Scotia Health Survey data was tested using multivariate models that included sex, age and data source as independent variables. Data source had no significant effect on the prevalence of self-reported hypertension ($p = 0.34$), of elevated blood pressure ($p = 0.46$) or of drug treatment ($p = 0.80$).

Of the 917 respondents interviewed in 1985, 274 (29.9%) had hypertension according to our definition (Table 1), and in 1995, 356 (26.6%) of the 1338 respondents reported hypertension. The characteristics of the respondents with self-reported hypertension for each survey sample are shown in Table 1. In Table 2 the characteristics of those reporting hypertension, stratified by blood pressure status, sex and age group at the time of the survey, are presented. Eighty-five (31.0%) of the respondents reporting hypertension in 1985 had elevated blood pressure; the corresponding number for respondents in 1995 was 138 (38.8%). The prevalence of hypertension did not differ sig-

nificantly over the 2 survey years ($p = 0.35$) except for the 45–54 year age group ($p = 0.02$), for which rates were lower in 1995. Significant differences were detected between each of the age groups ($p < 0.004$). Multivariate logistic regression with self-reported hypertension as the dependent variable and survey year, sex and age as independent variables indicated that age was the only significant predictor for hypertension ($p < 0.001$).

Respondents with self-reported hypertension were considered to be receiving pharmacologic treatment if they said hypertension control was the reason for taking medication with documented antihypertensive activity. This condition was met by 96 (35.0%) and 122 (34.3%) of those reporting hypertension in the 1985 and 1995 samples respectively (Table 1). The proportions of those receiving treatment, stratified by type of antihypertensive drug prescribed, are presented in Table 3. The number of different antihypertensive drugs prescribed by physicians increased from 21 in 1985 to 33 in 1995 (data not shown). There was a clear trend toward monotherapy, as indicated by the decline of combination treatment from 39.6% in 1985 to 15.6% in 1995. This shift was associated with a large increase in the use of calcium-channel blockers (from 2.1% to 19.7%) and angiotensin-converting-enzyme (ACE) inhibitors (from 5.2% to 25.4%); diuretic monotherapy declined from 31.3% to 17.2%. The type of drug differed among men and women; the most frequently prescribed antihypertensive treatment among men shifted from combination therapy in 1985 to β -adrenergic blockers and ACE inhibitors in 1995. Although the figure declined from 40.0% to 27.9%, diuretics were the most frequently prescribed antihypertensive among women in 1985 and 1995. In a multivariate logistic regression model with type of antihypertensive drug as the dependent variable and age, sex and survey year as independent variables, sex ($p = 0.002$) and survey year ($p < 0.001$),

Table 1: Characteristics of respondents with self-reported hypertension

Characteristic	No. (and %) of respondents with self-reported hypertension	
	1985 sample <i>n</i> = 274	1995 sample <i>n</i> = 356
Age group, yr*		
25–44	85 (31.0)	137 (38.5)
45–54	91 (33.2)	78 (21.9)
55–64	98 (35.8)	141 (39.6)
Female sex	142 (51.8)	186 (52.3)
Prescribed antihypertensive medication	96 (35.0)	122 (34.3)

*Since there were no 65- to 74-year-old respondents in the 1985 sample, this age group was not included in the overall analysis.

Table 2: Characteristics of respondents with self-reported hypertension, stratified by blood pressure status* at the time of the survey

Characteristic	No. (and %†) of respondents in 1985 sample			No. (and %†) of respondents in 1995 sample		
	Elevated BP	Normal BP	BP unknown	Elevated BP	Normal BP	BP unknown
Age group, yr						
25–44	16 (18.8)	64 (75.3)	5 (5.9)	36 (26.3)	76 (55.5)	25 (18.3)
45–54	34 (37.4)	52 (57.1)	5 (5.5)	31 (39.7)	36 (46.2)	11 (14.1)
55–64	35 (35.7)	56 (57.1)	7 (7.1)	71 (50.4)	52 (36.9)	18 (12.8)
Men						
Treated	15 (32.6)	27 (58.7)	4 (8.7)	35 (57.4)	22 (36.1)	4 (6.6)
Untreated	36 (41.9)	47 (54.6)	3 (3.5)	48 (44.0)	46 (42.2)	15 (13.8)
Subtotal	51 (38.6)	74 (56.1)	7 (5.3)	83 (48.8)	68 (40.0)	19 (11.2)
Women						
Treated	19 (38.0)	29 (58.0)	2 (4.0)	26 (42.6)	25 (41.0)	10 (16.4)
Untreated	15 (16.3)	69 (75.0)	8 (8.7)	29 (23.2)	71 (56.8)	25 (20.0)
Subtotal	34 (23.9)	98 (69.0)	1 (7.0)	55 (29.6)	96 (51.6)	35 (18.8)
Total	85 (31.0)	172 (62.8)	17 (6.2)	138 (38.8)	164 (46.1)	54 (15.2)

Note: BP = blood pressure.

*Elevated, systolic BP ≥ 140 mm Hg or diastolic BP ≥ 90 mm Hg; normal, otherwise; unknown, no valid BP data available.

†Percentages are based on row totals within each sample.



but not age ($p = 0.22$), were significantly associated with the type of therapeutic agent prescribed.

The prevalence of uncontrolled hypertension among respondents reporting hypertension (regardless of treatment status) is shown in Table 2. The unadjusted odds ratio (OR) for uncontrolled hypertension in 1995 relative to that in 1985 was 1.70. After adjusting for sex and treatment status (age was not significantly associated) the OR was 1.76 (95% confidence interval [CI] 1.23–2.51). The ORs for the covariates were as follows: men versus women, OR 3.0, 95% CI 1.92–4.78; treated versus untreated hypertension, OR 2.74, 95% CI 1.62–4.63. Men prescribed antihypertensive medication in 1985 were an exception to the trend seen with sex; they had a lower rate of hypertension than women receiving treatment and men not receiving treatment.

A logistic regression analysis for factors associated with controlled blood pressure in respondents receiving treatment for hypertension revealed that drug category ($p = 0.04$) and survey year ($p = 0.03$) were significant factors. The respondents in 1995 were more likely to have had uncontrolled blood pressure than those in 1985 (OR 2.10, 95% CI 1.08–4.07). When compared with diuretics, calcium-channel blockers (OR 3.25, 95% CI 1.10–9.64) and β -adrenergic blockers (OR 3.40, 95% CI 1.40–8.26) were significantly associated with less well-controlled blood pressure. No other drug category differences reached significance.

The average drug cost per respondent was influenced by the prescribing trend and the preference within drug categories (Table 3). The average daily cost of medication may have changed, although the drug of choice remained within the same category. In each drug category the cost data represent the average cost of the various agents encountered in our study within each category. The average overall daily cost of medication per respondent was significantly higher in 1995 than in 1985 ($p < 0.001$).

Interpretation

We found no sex-related differences, but there was a significant difference between age groups in the prevalence of self-reported hypertension. This confirms some of the findings of a survey of the Canadian population,²³ where no sex-related differences were detected (20% of men and 21% of women reporting hypertension), but there was a tendency for an increase in the prevalence of hypertension with age. Surprisingly, we found no significant difference in the prevalence of self-reported hypertension between survey years, despite a significant increase in the samples' mean blood pressure from 1985 to 1995.⁹ It is possible that in 1995 a larger proportion of respondents were unaware of their hypertension or that there was a differential response bias and more respondents who were aware of their hypertension refused to participate in 1995.

In accordance with statistics from the United States,²⁴ where the blood pressure of about 45% of people prescribed antihypertensive treatment exceeded 140/90 mm Hg, we also found that a substantial proportion of Halifax County residents prescribed antihypertensive medication had uncontrolled hypertension. Patient noncompliance may have been a factor. The cost of medication has been found to lead to noncompliance.^{25,26} Therefore, the increase in drug costs between 1985 and 1995 may, in part, be responsible for the higher prevalence of uncontrolled hypertension reported in 1995. However, patients' views on health care, poor physician-patient communication and physicians' perceived reason for treatment failure have also been identified as major reasons for uncontrolled hypertension.²⁶⁻²⁸

The prevalence of uncontrolled hypertension among respondents reporting hypertension increased with age. Physicians may have used higher blood pressure thresholds

Table 3: Types and costs of antihypertensive drugs prescribed to respondents

Drug class	No. (and %) of respondents in 1985 sample		No. (and %) of respondents in 1995 sample		1985 sample		1995 sample	
	Men	Women	Men	Women	Total no. (and %) of respondents	Avg. cost,* \$	Total no. (and %) of respondents	Avg. cost,* \$
Angiotensin-converting-enzyme inhibitor	3 (6.5)	2 (4.0)	18 (29.5)	13 (21.3)	5 (5.2)	1.03	31 (25.4)	0.91
β -adrenergic blocker	13 (28.3)	8 (16.0)	18 (29.5)	9 (14.8)	21 (21.9)	0.62	27 (22.1)	0.68
Calcium-channel blocker	1 (2.2)	1 (2.0)	14 (23.0)	10 (16.4)	2 (2.1)	1.07	24 (19.7)	1.24
Diuretic	10 (21.7)	20 (40.0)	4 (6.6)	17 (27.9)	30 (31.3)	0.05	21 (17.2)	0.10
Combination therapy or other drug†	19 (41.3)	19 (38.0)	7 (11.5)	12 (19.7)	38 (39.6)	0.63	19 (15.6)	1.32
Total	46 (100.0)	50 (100.0)	61 (100.0)	61 (100.0)	96 (100.0)	0.48	122 (100.0)	0.85

*Average daily drug cost (excluding dispensing fees) per patient.

†This category consists mostly of either a diuretic combined with 1 or more other antihypertensive drugs or other single antihypertensive agents (e.g., methyl dopa and clonidine) not included in the other drug classes.



for intervention among older people; we have no data to substantiate this hypothesis, however. In contrast with the male respondents, the women prescribed antihypertensive medication were at higher risk for elevated blood pressure than the women not taking medication. This may be related to the fact that a large proportion of women who reported hypertension but were not prescribed medication had normal blood pressure. It is conceivable that among the women with self-reported hypertension there were some with transient hypertension (e.g., during pregnancy or while taking oral contraceptives) who should not have been included in that group.

The change from 1985 to 1995 in the antihypertensive medications prescribed may have been driven in part by the marketing of new drugs, but it is also compatible with changes in practice guidelines. In 1985 hypertension therapy was based on the stepped-care principle, with diuretics or β -adrenergic blockers as first-line drugs²⁹ and an additional drug prescribed as needed. In accordance with these recommendations most patients were treated with diuretics, β -adrenergic blockers and combination therapy. The Canadian guidelines were revised in 1989;³⁰ it was recommended then that an ineffective drug be replaced with a single drug from another category. These recommendations may explain the decrease in the use of diuretics and combination therapy and the substantial increase in the use of calcium-channel blockers and ACE inhibitors. Lowering of the treatment threshold from 100 mm Hg to 95 mm Hg diastolic pressure³⁰ may also have contributed to the change. At a higher threshold the cases are more severe and would require combination therapy more often. The changes in prescribing trends reported here are similar to those of other Canadian studies^{32,33} and to those observed elsewhere.^{10,11,31}

The use of antihypertensive agents among men and women was similar, except that fewer diuretics and more β -adrenergic blockers were prescribed to men, primarily those 45–54 years of age. We cannot explain this finding. The prevalence of diabetes was similar among the men and women, and isolated systolic hypertension was insignificant in the 45–54 year age group. However, the use of β -adrenergic blockers among men who reported hypertension may reflect a concern for an increased risk of coronary artery disease.

The increased availability of new, more expensive antihypertensive medications was accompanied by a significant rise in the average daily treatment cost for a hypertensive patient in 1995 but was not associated with improved hypertension control. Despite a decrease in the use of combination therapy and a greater choice of drugs — which should have improved compliance — a greater proportion of those reporting hypertension had uncontrolled blood pressure. A shift of costs to the patients through increased copayments may have affected compliance; hypertension cases in 1995 may have been more difficult to treat, or response bias may have produced significantly different samples in 1985 and 1995.

Most residents of Halifax County live in an urban set-

ting; they are primarily engaged in knowledge-based or service industries, commercial fishing, forestry and light industry. As such, the population of Halifax County may be compared with the population of Canada as a whole, and our findings may be generalized beyond the local confines of Halifax County.

Our results may be limited by the relatively low participation rate. Also, many of our drug therapy data are based on respondent recall (all were not independently verified), and the single-time blood pressure measurements may have overestimated uncontrolled hypertension.³⁴ In addition, our design did not allow us to assign a cause to the change in antihypertensive drug preference between 1985 and 1995. Our cost data do not reflect the total cost charged to the patient, since dispensing fees and copayments were excluded, and there are likely to be significant price differences between pharmacies for the same medication.³⁵ The limitations of our dataset precluded a cost-effectiveness analysis.

Physicians in 1995 prescribed a wider range of antihypertensive drugs. This choice of drugs, with reportedly fewer associated side effects, did not result in better hypertension control. In fact, the reverse was observed with a concordant increase in treatment costs. The reasons for this are unknown but may be related to poor compliance with more expensive drugs. The finding that blood pressure was most commonly controlled in patients treated with the lowest priced drug is of note, particularly with current concerns about rising health care costs and evidence-based medicine. Uncontrolled hypertension remains a public health problem.

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- Reprint requests to:** Dr. Hermann K. Wolf, Department of Physiology and Biophysics, Dalhousie University, Halifax NS B3H 4H7; hermann.wolf@dal.ca