

Changing Trends in Hypertension Detection and Control: The Chicago Experience

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Abstract: Of 177,692 persons screened in 1977 as part of an ongoing City-Wide Hypertension Screening Program in Chicago, 14,988 (8.4 per cent) had diastolic blood pressure (BP) \geq 95 mm Hg as compared to 13.2 per cent of a similar population in 1976. Only 7 per cent (3,910) of the hypertensive population (diastolic BP \geq 95 mm Hg or presently on antipressor drugs) had previously undetected hypertension in contrast to 11.9 per cent (4,184) the year before and 48.7 per cent in the same community in 1972. Conversely, 73.2 per cent

(40,738) had adequately controlled blood pressure as contrasted to 59.3 per cent (20,897) the previous year and 20.6 per cent in 1972. Of the remaining hypertensives, 7.5 per cent (4,201) were known but not treated and 12.3 per cent (6,824) were under treatment but not controlled in contrast to 12.1 per cent (4,251) and 16.8 per cent (5,905) respectively the year before. This upward trend in controlled hypertension was present in all strata of the population. (*Am J Public Health* 70:389-393, 1980.)

Introduction

Although successful results of antihypertensive treatment were published by the Veterans Administration Cooperative Study group in 1967 and 1970, surveys of the status of hypertension detection and treatment conducted in the period between 1967 and 1972 revealed very high rates of undetected and low rates of adequately treated hypertension.¹⁻⁶ In order to improve this poor state of hypertension control, the National High Blood Pressure Education Program was inaugurated, stimulating hypertension detection programs in local communities.⁷ This report details the experience and results of such a program initiated in Chicago in 1975. Analysis of the data of the first two years of the program indicate a marked and continuing improvement in the detection and control of hypertension in Chicago confirming and extending trends previously reported.^{8, 9}

Methods

In February 1975, the City of Chicago initiated a Hypertension Screening and Referral Program designed to detect and bring under treatment as many hypertensives as possible. Mass media approaches were used to increase public awareness of the problem of hypertension. Television spots, press releases, and advertisement posters displayed on mass transportation vehicles were prepared, stressing the silent

nature of the disease and offering free blood pressure screening. Initial screening sites included the Richard J. Daley Center, comprehensive neighborhood health centers, store front clinics, mental health centers, fire stations, Park District field houses, and sites of large gatherings, such as flower and trade shows. Mobile units also were utilized. At the campaign peak, 55 different locations throughout the city were operational in hypertension screening. In the second year of operation screening was conducted at 12 fixed and multiple rotating mobile sites. The screening was performed by Department of Health Nurses, Fire Department Paramedics, and specially trained hypertension technicians utilizing a uniform screening procedure. All screening personnel underwent individual training and subsequent retraining in techniques of blood pressure measurement following the protocol of the Multiple Risk Factor Intervention Trial.* All persons screened completed a form requesting demographic data and answers to the questions, "Has a physician ever told you that you had high blood pressure?" and "Are you presently taking high blood pressure pills?" Two blood pressure determinations were taken at each screening with the highest reading used for statistical analysis.** After four months of testing the procedures and techniques, the data were accumulated and entered for statistical analysis.

*Multiple Risk Factor Intervention Trial Manual of Operations, Appendix G, National Heart Lung and Blood Institute, Washington, DC, 1976.

**Persons under age 40 with systolic pressure of 160 mm Hg or greater or diastolic pressure of 90 mm Hg or greater and persons age 40 or older with systolic pressure of 180 mm Hg or greater or diastolic pressure of 95 mm Hg or greater were asked to return for a second screening. If BP was still elevated, they were then referred for evaluation and possible treatment. All individuals with diastolic pressure of 130 mm Hg or more at any screening were referred for immediate evaluation. The criteria for referral and the number of persons referred will not be used in this statistical analysis.

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TABLE 1—Age-Race-Sex Distribution of Screenees in 1976 and 1977

Race	Age Groups (Male)													
	18-24		25-34		35-44		45-54		55-64		≥65		Unknown	
	1976	1977	1976	1977	1976	1977	1976	1977	1976	1977	1976	1977	1976	1977
Black	3288	2450	3480	3042	2276	2401	2056	2126	1662	1737	1728	1869	27	2
White	2673	3837	3506	5888	2731	4960	4679	8009	7522	12789	12678	20891	109	3
Other	260	394	559	783	416	613	341	530	238	351	312	606	7	3
Unknown	785	113	728	178	445	165	447	217	475	293	650	404	19	0

Race	Age Groups (Female)													
	18-24		25-34		35-44		45-54		55-64		≥65		Unknown	
	1976	1977	1976	1977	1976	1977	1976	1977	1976	1977	1976	1977	1976	1977
Black	3558	3269	3452	3913	2990	3469	3149	3595	2262	2768	2460	2910	46	4
White	3090	4802	2649	5625	2485	5571	5351	10692	10515	20318	17044	30805	112	7
Other	331	485	531	799	401	599	351	556	224	396	306	592	9	1
Unknown	454	134	487	184	389	202	486	285	579	411	883	616	3	1

Results

From July 1, 1975 through June 30, 1976 (Year 1976), 117,954 blood pressure determinations were made in this program. The number increased to 177,692 determinations from July 1, 1976–June 30, 1977 (Year 1977). The individuals screened came from every community area in Chicago. Their age, sex, and racial distribution are detailed in Table 1. The number and age distribution of Black males remained fairly constant in both years, being spread relatively evenly over all age levels except for slightly higher percentages in the younger age groups. More Black females were screened in 1977 with the age spread in both years being similar to Black males. The number of White persons screened, both male and female, increased in 1977. In both years a much larger percentage of Whites of both sexes were in age groups above 44 when compared to Blacks.

The racial distribution of the persons examined in 1976 differed only slightly from the Chicago population according to the 1970 census. Of the screened persons examined that year, 27.6 per cent were Black, in contrast to 33 per cent of the general population, and 62.9 per cent were White, in contrast to 66 per cent of the general population; 3.6 per cent were of other racial origin and racial origin was not recorded in 5.8 per cent of those examined. In 1977, 75.5 per cent of those screened were White, 18.9 per cent Black, 3.8 per cent other, and racial origin was undetermined in 1.8 per cent. These differing percentages reflect a much larger number of White screenees in the second year with a fairly constant number of Blacks in both years of the program.

The prevalence of elevated blood pressure is depicted in Table 2. The prevalence of systolic pressure equal to or greater than 160 mm Hg and of all levels of elevated diastolic pressure were significantly less in 1977.

TABLE 2—Prevalence of Elevated Blood Pressure Levels* in 1976 and 1977

	% 1976	% 1977
Systolic BP		
≥140	45.3	45.3
≥160	17.3	16.5**
Diastolic BP		
≥90	27.8	24.4**
≥95	13.2	8.4**
≥110	3.1	2.0**

*Highest of two measurements used in analysis

**P ≤ .001 (1977 value compared to 1976)

Mean systolic and diastolic blood pressure, depicted in Table 3, advanced with age in every race, sex group until the age of 60 after which diastolic blood pressure declined slightly. The mean levels were lower, however, in each race, sex group over the age of 30 in the second year of the survey. Both mean systolic and diastolic pressure were higher in Blacks than Whites in both years except for the youngest and oldest age groups.

In establishing the prevalence of hypertension, it is necessary to include those persons with blood pressure in excess of the normal cut-off point and those with a history of hypertension currently on drugs with blood pressures below that cut-off point at the time of screening. Utilizing any of three different cut-off points to establish hypertension prevalence,*** we found approximately one-third of the individ-

*** (1) diastolic blood pressure equal to or greater than 90 mm Hg, (2) diastolic blood pressure equal to or greater than 95 mm Hg, (3) or systolic blood pressure equal to or greater than 160 mm Hg and/or diastolic equal to or greater than 95 mm Hg.

TABLE 3—Mean Blood Pressure in 1976 and 1977*

Age	Black Male		White Male		Other Male		Black Female		White Female		Other Female	
	1976	1977	1976	1977	1976	1977	1976	1977	1976	1977	1976	1977
Under 30	123/76	123/77	127/76	126/77	123/76	121/77	116/74	115/75	117/74	116/73	113/72	113/71
30-39	131/81	130/85	129/82	128/81	126/81	124/79	127/84	124/82	121/77	121/76	119/77	118/76
40-49	137/90	136/89	134/86	133/84	133/86	132/85	136/89	134/87	130/82	128/80	130/82	128/81
50-59	144/91	141/89	140/86	139/85	139/87	138/87	144/90	140/88	138/84	137/82	137/83	135/83
60-69	148/89	145/87	147/85	145/84	145/86	145/85	149/87	146/86	145/83	144/82	144/82	144/83
70 and over	152/85	147/84	151/82	150/81	151/83	149/82	154/85	149/84	151/81	149/81	153/81	150/80

*Standard deviations have been computed and are available on request to the senior author.

uals screened to be hypertensive in both years of the survey (Table 4).

Defining hypertension as a diastolic blood pressure equal to or greater than 95 mm Hg or a history of hypertension and currently taking anti-hypertensive drugs regardless of blood pressure, 11.9 per cent of the hypertensives were previously undetected in 1976 and 7 per cent in 1977 (Table 5). The persons who knew of their hypertension but were not under treatment in 1976 fell from 12.1 per cent to 7.5 per cent in 1977; those under treatment but with diastolic blood pressures equal to or greater than 95 mm Hg fell from 16.8 to 12.3 per cent. In contrast, the proportion of the hypertensive population whose blood pressure was adequately controlled rose from 59.3 per cent in 1976 to 73.2 per cent in 1977. These changes were all highly significant ($p \leq .001$) and occurred in all ethnic and sex groups.

For all segments of the population, blood pressure control improves with advancing age and was better in 1977 than in 1976 (Table 6). The changes are statistically significant ($p \leq .001$) for both Blacks and Whites at all ages. Control remains better in Whites than Blacks in both years of the survey. However, it should be noted that a majority of the hypertensive Black males under age 55 are still uncontrolled.

Discussion and Conclusions

When compared to previous reports dealing with the state of hypertension control both in Chicago^{3, 4} and else-

TABLE 4—Prevalence of Hypertension* in 1976 and 1977

Cut-Off Point	1976		1977	
	N	%	N	%
Diastolic BP \geq 90 or on drugs	38,581	33	61,352	35
Diastolic BP \geq 95 or on drugs	35,238	30	55,673	31
Systolic BP \geq 160 and/or Diastolic BP \geq 95 or on drugs	40,007	34	63,781	36

*Hypertension defined as BP above given cut-off point at time of screening or on anti-pressor drugs at time of screening and BP below the given cut-off point.

where,^{5, 6, 8, 9} the current survey indicates a marked and continuing improvement.

The Chicago Heart Association Screening-In-Industry Program, which surveyed employees ages 25 to 64 years of selected Chicago area industrial organizations between 1967 and 1972, revealed a high rate (49 per cent) of undetected and a low rate (20 per cent) of adequately controlled hypertension. Subsequent surveys have indicated an improvement in hypertension awareness and control. The Hypertension Detection and Follow-up Program, using different population groups in 14 selected communities, and the Community Hypertension Evaluation Clinic, screening over 1 million unselected persons in 1,171 sites, found the rates of un-

TABLE 5—Hypertension Treatment Status by Race and Sex in 1976 and 1977

	Black Males		White Males		Other Males		Black Females		White Females		Other Females		ALL	
	1976	1977	1976	1977	1976	1977	1976	1977	1976	1977	1976	1977	1976	1977
Previously Unknown	861 (20.5)	645 (15.0)	1,451 (13.4)	1,433 (8.2)	76 (15.5)	96 (11.9)	699 (11.5)	478 (7.2)	1,035 (7.8)	1,112 (4.6)	62 (15.0)	43 (5.9)	4,184 (11.9)	3,910 (7.0)
Previously Known but not Treated	805 (19.1)	637 (14.8)	1,190 (11.0)	1,231 (7.0)	78 (15.9)	112 (13.9)	1,107 (18.3)	879 (13.3)	1,020 (7.7)	1,161 (4.7)	51 (12.3)	59 (8.0)	4,251 (12.1)	4,201 (7.5)
Treated, but Diastolic BP still \geq 95 mm Hg	961 (22.8)	873 (20.3)	1,781 (16.4)	2,150 (12.2)	106 (21.6)	131 (16.2)	1,400 (23.1)	1,300 (9.7)	1,604 (12.1)	2,073 (8.5)	54 (13.0)	105 (14.3)	5,906 (16.8)	6,824 (12.3)
Treated and Controlled Diastolic BP < 95 mm Hg	1,582 (37.6)	2,137 (49.8)	6,439 (59.3)	12,765 (72.6)	231 (47.0)	468 (58.0)	2,847 (47.0)	3,946 (59.8)	9,551 (72.3)	20,087 (82.2)	247 (59.7)	527 (71.8)	20,897 (59.3)	40,738 (73.2)

Per cent shown in parentheses.

TABLE 6—Per Cent of Hypertensives Controlled* in 1976 and 1977: Age-Sex-Race Comparison

Age	Black Males		White Males		Other Males		Black Females		White Females		Other Females	
	1976 %	1977 %	1976 %	1977 %	1976 %	1977 %	1976 %	1977 %	1976 %	1977 %	1976 %	1977 %
<35	21	23	33	44	32	46	33	44	40	47	48	56
35-44	25	33	34	49	32	47	32	45	46	63	48	56
45-54	34	47	44	61	42	46	42	55	56	70	49	67
55-64	45	58	59	71	56	59	52	65	69	80	69	72
65+	57	73	70	81	62	74	66	75	79	87	73	84

*Per cent of total hypertensive population who have known of hypertension, were on anti-pressor drugs at time of screening, and had diastolic BP < 95 mm Hg.

detected hypertension to be 25 per cent and 28 per cent respectively, and the rates of controlled hypertension to be 38 per cent and 45 per cent respectively of their screened hypertensives.^{8, 9} The results of the present survey indicate further marked improvement. The rate of undetected hypertension has fallen from 49 per cent in the earlier Chicago survey to 7 per cent in 1977 and the rate of adequately treated hypertension has risen from 20 per cent to 73 per cent.

Comparison of the two Chicago surveys by sex, and race reveals that the improvement in hypertension control extends to all segments of the population (Table 7). Previously, undetected hypertension has dropped from 61.7 per cent to 15.0 per cent in Black males, from 54.9 per cent to 8.2 per cent in White males, from 40 per cent to 7.2 per cent in Black females and from 36.6 per cent to 4.6 per cent in White females. Conversely, controlled hypertension has risen from 7.4 per cent to 49.8 per cent in Black males, from 15.1 per cent to 72.6 per cent in White males, from 24.8 per cent to 59.8 per cent in Black females, and from 32.2 per cent to 82.2 per cent in White females. Further stratification of each sex, race group by age reveals that although in the age group 25-64 a greater percentage of the industrial workers were under the age of 45 (31 per cent vs. 19 per cent), a marked improvement in detection and control has still occurred in each age group. These rates for controlled hypertension are remarkably similar to those recently reported for selected communities in Baltimore, Birmingham, and Davis¹⁰ and preliminary results from the State of Maryland.¹¹

Although the results of the current survey and the trend it depicts are impressive, certain cautions must be expressed in the comparisons made and the interpretation of the data. Ideally, the assessment of hypertension prevalence and control would result from surveying a selected, representative sample of the entire population under consideration. Neither the Chicago Heart Association Screening-In-Industry Program, the Hypertension Detection and Follow-up Program, the Community Hypertension Evaluation Clinic, or the current survey meet this criterion. The former two samples were selected but not necessarily representative, and the latter two were unselected and not necessarily representative. There is no way of knowing how many of the hypertensives in an unselected sample came for screening to see if their blood pressure was indeed under control, thereby skewing the data.

Furthermore, it is well recognized that several elevated blood pressure measurements are necessary to establish a diagnosis of hypertension, and some of the individuals so classified in any screening survey limited to one set of measurements may be inaccurately labeled. One may also question how many of the treated and controlled hypertensives did not have diastolic blood pressure equal to or greater than 95 mm Hg at the onset of treatment and therefore do not truly belong in a hypertensive population. These potential sources of error are present not only in the present survey, but also in those against which it is compared.

Nevertheless, the trend toward improved detection and control over time and in both years of the survey is consistent,

TABLE 7—Comparison of Hypertension Treatment Status by Race and Sex 1967-1972 (CHA) and 1977 (Current Survey)

	Black Males		White Males		Black Females		White Females	
	1967-72	1977	1967-72	1977	1967-72	1977	1967-72	1977
Previously Unknown	158 (61.7)	645 (15.0)	1564 (54.9)	1433 (8.2)	84 (40.0)	478 (7.2)	580 (36.6)	1112 (4.6)
Previously Known but not Treated	50 (19.5)	637 (14.8)	520 (18.2)	1231 (7.0)	37 (17.6)	879 (13.3)	265 (16.7)	1165 (4.7)
Treated, but Diastolic BP still ≥ 95 mm Hg	29 (11.3)	873 (20.3)	337 (11.8)	2150 (12.2)	37 (17.6)	1300 (19.7)	229 (14.5)	2073 (8.5)
Treated and Controlled Diastolic BP < 95 mm Hg	19 (7.4)	2137 (49.8)	429 (15.1)	12765 (72.6)	52 (24.8)	3946 (59.8)	509 (32.2)	20087 (82.2)
TOTAL (100%)	256	4292	2850	17579	210	6603	1583	24443

Per Cent shown in parentheses

and the temporal relations argue that the changes which have occurred are real, even though the population groups are not strictly comparable. This position is supported by the results from selected communities in Boston and Davis, reported in 1978, which parallel those of the 1976 year of the current survey.¹⁰ Furthermore, a 1979 preliminary report from a selected, representative sample of the entire State of Maryland yielded results almost identical to those of the 1977 year of the current survey.¹¹

The poor state of control of the earlier Chicago Heart Association Industrial Workers indicated the lack of awareness then existent on the part of the medical profession as well as the general public of the importance of hypertension control, a situation essentially unchanged from the National Health Examination Survey of 1960-1962.¹² The improved control in the present survey reflects, at least in part, the efforts of the National High Blood Pressure Education Program, of programs at the local level sponsored by public and voluntary health agencies, and a change in the attitude of the medical profession towards hypertension and its treatment.

The current data reflect a particularly noteworthy improvement in the status of those over the age of 45. It should be noted, however, that in 1977, a majority of male hypertensives of all races under the age of 45 and a majority of Black females under age 45 were still undetected or inadequately treated; two-thirds of the Black male hypertensives under age 45 were uncontrolled. These data indicate the need for continuing education, detection, and treatment programs in these strata of the population.

REFERENCES

1. Veterans Administration on Cooperative Study Group on Anti-hypertensive Agents: Effects of treatment on morbidity in hypertension: I. Results in patients with diastolic blood pressure averaging 115 through 129 mm Hg. *JAMA* 202:1028-1034, 1967.
2. Veterans Administration Cooperative Study Group on Anti-hypertensive Agents: Effects of treatment on morbidity in hypertension: II. Results in patients with diastolic blood pressure averaging 90 through 114 mm Hg. *JAMA* 213:1143-1152, 1970.
3. Schoenberger JA, Stamler J, Shekelle RB, Shekelle S: Current status of hypertension control in an industrial population. *JAMA* 222:559-562, 1972.
4. Lindberg HA, Berkson DM, Stamler J, et al: The frequency, adequacy and significance of treatment by practicing physicians of hypertensive males employed by the People's Gas Co. Paper presented to the Council of Epidemiology, American Heart Association, February 1972.
5. Wilber JA: Detection and control of hypertensive disease in Georgia, USA, In Stamler J, Stamler R, Pullman TN (eds): *The Epidemiology of Hypertension*. New York, Grune & Stratton Inc., 1967, pp 439-448.
6. Wilber JA, Barrow JG: Reducing elevated blood pressure-experience found in a community. *Minn Med* 52:1303-1305, 1969.
7. U.S. Department of Health, Education, and Welfare, Public Health Service, National Institutes of Health, National Conference on High Blood Pressure Education: Report on Proceedings. DHEW Publication No. (NIH) 73-486, 1973.
8. Stamler J, Stamler R, Riedlinger W, et al: Hypertension screening of 1 million Americans, Community Hypertension Evaluation Clinic (CHEC) Program, 1973 through 1975. *JAMA* 235:2299-2306, 1976.
9. Hypertension Detection and Follow-up Program Cooperative Group: Blood Pressure studies in 14 communities, a two-stage screen for hypertension. *JAMA* 237:2385-2391, 1977.
10. Oberman A, Blaszkowski T, Kraus J, et al: Epidemiology of High Blood Pressure Control. Abstracts of the 18th Annual Conference on Cardiovascular Epidemiology, 63, 1978 Council on Epidemiology, American Heart Association, Orlando FL, Mar 13-16, 1978.
11. George E, Apostolides A, Su Sol, Brandon B: High Blood Pressure Control in the State of Maryland. Abstracts of the 19th Annual Conference on Cardiovascular Epidemiology, 71, 1979 Council on Epidemiology, American Heart Association, New Orleans, LA, Mar 19-21, 1979.
12. Blood Pressure of Adults by Race and Area United States, 1960-62, National Health Survey, Vital and Health Statistics Series 11, No. 5: U.S. Department of Health, Education and Welfare, Public Health Service, 1964.

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