Impact of Hypertension Information on High Blood Pressure Control Between 1973 and 1978

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SUMMARY To determine whether the immense multifocal efforts in the United States over the past 7 years to detect and treat high blood pressure (BP), had affected the status of hypertension, data from a national household survey in 1973-74 were compared with data obtained in 1977-78 from a second non-overlapping population in the same three communities. The impact of hypertension programs was measured by assessing change over the 5-year period in BP distribution, degree of awareness, and level of treatment in the population. Our data show that a substantial improvement in the status of high BP detection, treatment, and control has occurred since the early 1970s for all age, sex, and race groups studied. (Hypertension 2: 708-713, 1980)

KEY WORDS • hypertension • prevalence survey • blood pressure control programs

IN THE early 1970s there were unprecedented efforts in public and health-professional education in high blood pressure (BP) control by government,1 voluntary agencies, and private groups. Concurrently, a national collaborative trial was implemented to test the hypothesis that rigorous treatment of hypertension in a community setting was effective and feasible in reducing mortality and related morbidity. This trial is known as the Hypertension Detection and Follow-Up Program (HDFP) and has just been recently concluded in 14 U.S. centers.2

The Impact of Hypertension Information Study (IHI) was a necessary part of the HDFP to evaluate the impact of the HDFP as well as the unprecedented national efforts of others aimed at increasing the level and degree of awareness of high BP in the general population.

Because hypertension is one of this country's most important health problems, numerous federal, state, local, and private programs have been established in the past 10 years for its detection and treatment. Yet there is little or no concrete evidence of change in hypertension status at the community level to justify these efforts. The IHI study attempted to measure, for the first time, the impact of national education efforts at screening, detection, and therapy by many separate groups. If these activities have been successful, it is logical to expect less high BP in the community — namely, fewer persons with undetected high BP, more with high BP being treated, and fewer under treatment who do not have their BP under control.

The extensive screening efforts conducted by the HDFP during 1973-1974 offer a definitive database with which to assess the impact of hypertension activities, measured in terms of awareness, management, and control of hypertension. In three HDFP clinics (Baltimore, Maryland; Birmingham, Alabama; and Davis, California) random sampling in a defined population was used for the baseline survey. This sampling scheme allowed for a second non-overlapping repeat survey in the same target population 5 years later, the IHI, which used the same design to determine the changing status of hypertension detection, treatment, and control, as well as knowledge, attitude, prior awareness, and prevalence, by comparing the 1973-1974 and 1977-78 population samples in these three communities. This provides a unique opportunity to interpret quantitatively the impact of health education in this population.

This present report does not aim to elucidate completely the cause or source of the changes in hypertension control from 1973-74 to 1977-78, but does document the degree of change that has occurred.
Methods

In 1973, the HDFP began screening in 14 general communities throughout the U.S. with the intent of identifying hypertensives suitable for randomization into the program. This program screened over 159,000 individuals and defined the status of hypertension control in these 14 communities during the period from 1973–74. The target populations were selected on the basis of defined geographic areas, random sampling, or, in one center, employment in work settings. Three of the 14 communities chose a random sampling process to select the households to be enumerated and screened. In these three communities (Baltimore, Birmingham, and Davis) the opportunity was present to repeat a prevalence screen by taking a second non-overlapping random sample of the same target population at a subsequent point in time. The sample sizes were computed within each race-sex group such that there would be 90% power to detect a 10% decrease in the proportion of uncontrolled hypertension found in 1973–74, allowing a 5% (α-level) chance for error.

Based on this design, a total of 2570 persons (347 black males, 737 black females, 365 white males, 1121 white females) with hypertension were needed. Actual hypertensives were defined as those with diastolic BP greater than or equal to 95 mm Hg, or reportedly taking antihypertensive drugs as ascertained by the following indexed sequential questions: 1) “Have you ever been told by a doctor that you had high blood pressure?” If the answer was affirmative: 2) “How many years ago were you first told that you had high blood pressure?” 3) “Have you ever taken high blood pressure medicine that a doctor prescribed for you?” If the answer was yes: 4) “Are you still taking medicine for high blood pressure?”

Larger samples were needed for those subgroups of the study population having the highest proportion of persons with BP under control (e.g., < 90 mm Hg) to detect a 10% decrease from 1973–74 to 1977–78.

In all three centers, the second random sampling design, the IHI, was identical to that of the original HDFP survey. All samples were based on household selection. Specifically, in Baltimore, the IHI black study population included a 20% random sample of households from the same 17 census tracts, which were targeted for the HDFP in 1973–74. In Birmingham, Alabama, the city was divided into eight strata on the basis of land value. A 1% random block sample was drawn from each of these strata, and a field worker then visited each of the 55 blocks that had been drawn. Next, a detailed sketch map was prepared of each block. Repeated allocations were made in the manner above to attain the necessary sample size for the city of Birmingham, which was composed of both blacks and whites.

The sampling design in Davis, California, included a two-stage stratified random sample with a first-level stratum composed of enumeration districts within the three major population areas of Yolo County, California. The second stratum was a random sample of households located in the selected enumeration districts. The sampled population in Davis was all white.

To obtain a truly non-overlapping sample of the same age (30–69 years) as the HDFP sample, all households selected in 1973–74 were excluded from the IHI sample and, if individuals identified in the HDFP moved to a new target household, these persons also were excluded from the IHI sample. Those who moved into the study areas between 1973 and the time of the IHI were assumed to have the same population characteristics as the people who moved out during the same interval. The number of such persons, however, was not known.

Each household was enumerated by a trained interviewer, and individuals who were age-eligible were approached for screening in their homes. Blood pressure measurements were taken with the mercury sphygmomanometer (Baum Model 750 with V-lok cuff) by interviewers who were trained according to the same standardized protocol for the measurement of BP as in the HDFP, and were required to pass the certification procedure administered by the coordinating center in Houston. The measurements were taken on the right arm with the systolic pressure (SBP) and 5th phase diastolic pressure (DBP) recorded to the nearest 2 mm Hg. After the person had answered a series of demographic, social, and health questions, and had been seated at least 5 minutes, three readings were recorded for each individual with the mean of the second and third readings used to define the BP level for an individual. The questionnaire used in 1973, was, up through the measurement of the BP, identical to that used in the 1977–78 survey. This comparability was done to ensure that all questions preceding the BP measurements and the occurrence in time sequence of the measurement remained identical to the earlier survey. The questionnaire included demographic information, high BP awareness and treatment status, health beliefs and practices, and patient-derived recall of information on medical conditions, symptoms, and hypertension information sources. Procedures for sample selection, interviewing, BP measurements, and referral for second visits were identical, except as indicated above, for the surveys of 1973–74 and 1977–78.

Results

Of the 82,000 persons enumerated for the HDFP from February, 1973, into the summer of 1974, nearly 41% were in the age range of 30–69 years. Of the 32,000 persons in the IHI screen of 1977–78, nearly 43% were in this age range. In 1973–74, 53% were of the ages 30–49 years compared to 57% in the ages 30–49 in the 1977–78 IHI enumeration. During the HDFP screening effort, the three centers screened nearly 32,000 (94%) of the age-eligibles enumerated in 1973–74 compared with about 12,000 (90%) in the 1977–78 IHI survey. The slightly lower rate of participation in the latter survey appeared to be related to the shortened survey period, which was less than half the duration of the HDFP screen.
Age, Race, Sex

The age distribution of persons screened by race and sex for the HDFP and IHI surveys show very slight differences in the percentage distributions. For example, percentages for black males in Baltimore were: 42% for ages 30-49 in the HDFP compared with 41% in the IHI. For white males (ages 30-49) in Birmingham, the percentages screened during the HDFP was 48%, with an identical proportion screened in the IHI. In Davis, 61% of white males 30-49 years of age were screened for the HDFP compared to 65% for the IHI. At the 1% level (to adjust for repeated testing) of significance, no meaningful differences in screening by age were found for black males or females in the Birmingham surveys.

Significant differences were found among the age distributions of white females and black males in Birmingham. The differences exhibited for white females appeared to be a less uniform distribution of screenees across ages, with a slight excess of women over 50 years. For black males, there tended to be a slight excess of younger males. For the whites in Davis, significant differences in the ages of persons screened were found for both white males and white females. The differences found in Davis are probably related to the rapid growth in this college town during the period of 1973-1977. The changes in age distribution in Birmingham and Davis necessitated age-adjusting to the HDFP screened population for certain comparisons. All data presented in this report have been age-adjusted by the direct method to the HDFP age structure and center mix, where appropriate.

Table 1 shows the number of age-eligibles screened in the HDFP and IHI survey by age, race, and sex, to provide the baseline data for the percentages that follow. The HDFP subgroups are generally three times as large as those for the IHI subgroups. The smallest IHI subgroup is made up of 339 black males aged 40-49 years.

The average DBP found in 1973-1974 was 83.2 mm Hg. The age-race-sex and center-adjusted value in 1973-78 was 81.7 mm Hg, a decrease of 1.5 mm Hg; for an overall 1.8% decline in the average DBP. Figure 1 shows the mean center-adjusted DBP by race, sex, and age for the HDFP and IHI surveys. The reductions in mean DBP varied by age, but all center-adjusted values show declines in each race-sex group. For example, in black males, the mean DBP was 88.7 mm Hg in the HDFP survey compared with 88.4 mm Hg in the IHI. The declines were from 86.3 to 84.4, 82.7 to 81.6 and 78.3 to 76.9 mm Hg for black females, white males, and white females respectively.

Figure 2 shows the associated decline in the prevalence of elevated BPs (DBP ≥ 95 mm Hg) in this population regardless of treatment status. Females showed greater absolute declines as well as relative differences than did males. Black females showed the greatest declines in percent elevated BP, 3.8%, (19.8-16.0) compared with 3.0% for white females. However, white females and males had a twofold edge in the magnitude of the relative difference; i.e., the percentage change from the HDFP screen showed 39.0% for white females compared with 19.2% for black females; 22.7% for white males compared with 10.2% for black males.

Table 2 shows consistent declines in prevalence of elevated BP by age, sex, and race, the lone exception being for black males aged 40-49 years. Large differences between the HDFP and IHI are seen for persons over 50 years old where reductions in prevalence generally exceeded 4%.

The prevalence of SBPs greater than or equal to 160 mm Hg for the HDFP and IHI surveys show a decline in every race-sex-age subgroup for the IHI survey (table 3). The declines are large in almost all instances and consistent with treatment data to be presented below. Since the study design and sample sizes were generated on the basis of DBP, the remainder of the paper will focus on DBP results. The figures given in table 3 are included to provide evidence for the consistency of the findings and the applicability of the results to systolic pressures.

Figure 3 shows the trends in percentage of actual hypertensives previously aware of their high BP for each race-sex group. The impact of this increased awareness, that is, the percentage reduction in the number of hypertensives previously unaware of their condition, was about 28.5% [(74.9-64.9)/(100-64.9) X 100] for black males compared to 27.8% for black females. The impact was 34.3% for white females and 40.9% for white males. Overall, the impact was greater in whites than blacks regardless of sex.

Figure 4 shows the percentage of "actual" hypertensives who currently reported therapy for high BP. "Actual hypertensives" refers to those with a mean DBP of 95 mm Hg or greater or reported they

Table 1. Number of Age-Eligible Participants in the HDFP and IHI by Age, Race, and Sex for the Three IHI Study Centers

<table>
<thead>
<tr>
<th>Age group (yrs)</th>
<th>Black males HDFP</th>
<th>Black females HDFP</th>
<th>White males HDFP</th>
<th>White females HDFP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IHI</td>
<td>IHI</td>
<td>IHI</td>
<td>IHI</td>
</tr>
<tr>
<td>30-39</td>
<td>834</td>
<td>338</td>
<td>1654</td>
<td>506</td>
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<tr>
<td>40-49</td>
<td>1199</td>
<td>339</td>
<td>2017</td>
<td>567</td>
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<tr>
<td>50-59</td>
<td>1445</td>
<td>404</td>
<td>2031</td>
<td>642</td>
</tr>
<tr>
<td>60-69</td>
<td>1203</td>
<td>409</td>
<td>1641</td>
<td>515</td>
</tr>
<tr>
<td>All ages</td>
<td>4681</td>
<td>1510</td>
<td>7343</td>
<td>2230</td>
</tr>
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</table>

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TABLE 2. Prevalence Percent of Elevated Diastolic Blood Pressure by Age, Race, and Sex: HDFP and IHI (Center Adjusted)

<table>
<thead>
<tr>
<th>Age group (yrs)</th>
<th>Black males HDFP</th>
<th>Black females HDFP</th>
<th>Black males IHI</th>
<th>Black females IHI</th>
<th>White males HDFP</th>
<th>White females HDFP</th>
<th>White males IHI</th>
<th>White females IHI</th>
</tr>
</thead>
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<tr>
<td>30-39</td>
<td>17.8</td>
<td>12.5</td>
<td>11.4</td>
<td>8.5</td>
<td>6.5</td>
<td>3.9</td>
<td>2.1</td>
<td></td>
</tr>
<tr>
<td>40-49</td>
<td>26.8</td>
<td>20.9</td>
<td>17.9</td>
<td>14.4</td>
<td>12.5</td>
<td>7.9</td>
<td>5.7</td>
<td></td>
</tr>
<tr>
<td>50-59</td>
<td>28.2</td>
<td>24.6</td>
<td>18.9</td>
<td>15.8</td>
<td>11.5</td>
<td>10.4</td>
<td>7.1</td>
<td></td>
</tr>
<tr>
<td>60-69</td>
<td>25.6</td>
<td>19.7</td>
<td>14.8</td>
<td>13.4</td>
<td>9.4</td>
<td>9.3</td>
<td>4.2</td>
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</tr>
</tbody>
</table>

FIGURE 1. Mean diastolic blood pressure (DBP) by age, race, and sex: HDFP (1973-74) and IHI (1977-78).

FIGURE 2. Change in prevalence of elevated diastolic blood pressure: HDFP (1973-74) and IHI (1977-78) (DBP ≥ 95 mm Hg).

FIGURE 3. Percent of actual hypertensives previously aware of their elevated blood pressure: HDFP (1973-74) and IHI (1977-78).
TABLE 3. Prevalence Percent of Elevated Systolic Blood Pressures by Age, Race, and Sex: HDFP and IHI (Center Adjusted)

<table>
<thead>
<tr>
<th>Age group (yrs)</th>
<th>Black males HDFP</th>
<th>Black females HDFP</th>
<th>White males HDFP</th>
<th>White females HDFP</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-39</td>
<td>8.9</td>
<td>3.6</td>
<td>1.3</td>
<td>0.9</td>
</tr>
<tr>
<td>40-49</td>
<td>14.4</td>
<td>11.5</td>
<td>4.2</td>
<td>4.3</td>
</tr>
<tr>
<td>50-59</td>
<td>21.2</td>
<td>17.3</td>
<td>8.9</td>
<td>9.9</td>
</tr>
<tr>
<td>60-69</td>
<td>28.7</td>
<td>20.5</td>
<td>17.0</td>
<td>17.5</td>
</tr>
<tr>
<td>69+</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

were under drug treatment for hypertension. The absolute differences consistently increased, and the changes are large. The relative differences range from 17% increase in those treated for black females to a 20% increase for white females; 20% for black males and 45% for white males. The result of increased treatment is to reduce the proportion untreated by 24%, 33%, 31%, and 36% for black and white males and females respectively.

Finally, the most important data from the IHI study are seen in figure 5, which shows the changes in the control of high BP. In each race-sex group, a consistent increase in the proportion controlled is seen: 15% higher for black males, 14% higher among black females, 16% for white males, and 17% for white females. The percentage changes in those under control (the relative differences) are 53%, 30%, 57%, and 33% for the four race-sex groups respectively. Finally, the impact shows larger than expected results. The study design was based on an estimated 10% reduction in uncontrolled actual hypertensives. This was exceeded by at least twofold in each race-sex group. For black males a 21% reduction in uncontrolled hypertensives who were treated was obtained, 27% for black females, 22% for white males, and nearly 36% for white females.

The 36% change (decrease) in the proportion of uncontrolled hypertensives was substantial enough so that each of the four race-sex hypotheses was highly statistically significant with $p$ values less than 0.001, and these results were consistent for nearly all age-race-sex and center subgroups.

Discussion

Concurrent with the considerable effort by the American Heart Association and other organizations, the federal government set in motion the National High Blood Pressure Education Program (NHBPEP) in June, 1972. As the HDFP was ending its screening
efforts in 1974, the NHBPEP began its intensive media campaigns. The collaborative government and private sector endeavor concentrated its efforts in the areas of education development and services. Our data seem to show that the large-scale efforts on high BP control by government and the private sector during the 1970s has had a beneficial effect. Although these data reflect only three communities and are not representative of the U.S. as a whole, data from other sources support this finding on a more generalized basis. Besides the more general efforts at hypertension education and control, another possible explanation is the existence of the HDFP in the three communities studied. The communities may have become more attuned to BP control because of the HDFP, but it is not possible to isolate the specific factors responsible for the improvements observed. It should be noted that substantial differences exist in the target populations of these three centers, but only minor differences are seen in the age, race, sex groups among centers, and, with only one exception, the direction of the results are consistent.

The extensive efforts to maintain comparability in all aspects of the HDFP and IHI surveys, including complete similarity in questionnaire wording and sequencing and design of non-overlapping random samples, convince us that the changes in BP control are real and meaningful. Whether a 20% decline in hypertensives who are treated and uncontrolled is a national phenomenon is debatable, but the fact that a substantial impact has been achieved is undeniable.

Findings from the IHI are not unique, but little national data has been published on changes in BP control. Data published by the National Center for Health Statistics comparing the 1960-62 Health Examination Survey (HES) with the results of the 1971-74 Health and Nutrition Examination Survey (HANES) do not totally bear out the trend reported from our data. For example, while the percent of adults with DBP $\geq 105$ mm Hg or over is substantially higher in the HANES, than for the earlier HES, the findings for SBP are consistent with our data. Also, data from HES and HANES show that the percent of persons never diagnosed as hypertensive (unaware) among those with borderline hypertension (SBP $\leq 160$ mm Hg and DBP $\leq 95$ mm Hg, but not both below 140 mm Hg and 90 mm Hg) declined from 82.9% in 1960-62, to 76.1% in 1971-74. Among definite hypertensives (SBP $\geq 160$ mm Hg or DBP $\geq 95$ mm Hg) the percentages of persons unaware of their elevated BP dropped from 58.0% in 1960-62 to 54.9% in 1971-74.

The consistent increases in awareness, treatment, and control are significant in this first assault on a major chronic condition. Other evidence of benefit is surfaced by way of the decline in CHD mortality rates, but the true impact cannot be measured solely in mortality; morbidity must also be considered.

Although the factors that have produced the changes observed need further study and clarification, the basic ingredients for effective change are present. Physical anthropologists have claimed that culture is man's principal adaptive mechanism, and hypertension has been labeled as a cultural issue with a societal focus. Cultural adaptation has been invoked in the past in order to increase the chances of survival (e.g., acceptance of mass immunization). The benefits of long-term community-based programs of therapy for hypertension, as demonstrated in the HDFP, is another example of beneficial cultural adaptation. These efforts must be continually monitored, for our period of observation was only a 5-year cross-sectional comparison, and the changes observed may not persist. Compliance, adherence, and continued detection are serious issues to be resolved as the priorities change from past successful endeavors. In addition, we must await the evidence of long-term benefits weighed against untoward risks.

In summary, we conclude from the evidence presented above that the massive efforts in hypertension screening, treatment, and control have had considerable impact on the status of BP levels in three U.S. communities. This impact was measured in terms of lowered prevalence of elevated pressures, greater awareness among the actual hypertensives, as well as greater treatment and control of high blood pressure.

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