FAMILY MEDICINE AND THE HEALTHCARE SYSTEM

The New "Normal" Blood Pressure: What Are the Implications for Family Medicine?

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Background: In 2003, the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure redefined normal blood pressure (BP) as less than 120/80 mm Hg and added the category of prehypertension, recommending that such patients receive counseling on lifestyle modifications. Based on population data, 41.8% of US adults have normal BP, 31% have prehypertension, and the remainder has hypertension. These percentages may not reflect the proportions seen in family medicine practices. The purposes of this study were to describe the proportion of adults in a family medicine practice with normal BP and the proportions with prehypertension and hypertension and to examine associations with having normal BP.

Methods: Records of 633 nonpregnant adults from a large family medicine clinic were reviewed for demographic and BP information. Proportions of subjects in each BP category (normal, prehypertension, or hypertension) were determined. Characteristics associated with normal BP were examined using χ^2 tests and logistic regression.

Results: Nearly 80% of adults in this population had prehypertension or hypertension. Subjects more likely to have normal BP were young, female, white, and not overweight/obese. Almost 60% of subjects had documented hypertension, were receiving antihypertensive medications, or had a BP on the day of visit ≥140/90 mm Hg. Over 20% had prehypertension.

Conclusion: The proportion of adult family medicine patients with normal BP is low. Counseling 20% of adult patients about prehypertension while continuing to strive to improve BP control for the 60% of patients with hypertension could pose a new challenge to clinicians working in family medicine offices. (J Am Board Fam Med 2007;20:45–51.)

The nature of a clinician's work is to collect information so that a decision can be made regarding a course of action to improve a person's health. Such work often dictates that complex information be viewed in a way that can contribute to a decision that something is either normal or abnormal. In medicine, this notion often means that data based on a continuous scale must be dichotomized. In current practice, such has traditionally been the

case with blood pressure (BP). Through a series of repeat BP measurements over time, a clinician makes a decision whether or not to make a diagnosis of hypertension. This decision is generally based on a threshold above that BP—taking into account various comorbidities—considered elevated enough to justify treatment with medications to reduce cardiovascular disease (CVD) risk. For most patients, this threshold is sustained office BPs greater than 140 mm Hg systolic or 90 mm Hg diastolic.

In 2003, the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7) defined a new category of BP called prehypertension.[1] The prehypertension category includes nonhypertensive adults with BP between 120 to 139 mm Hg systolic or 80 to 89 mm Hg diastolic. JNC 7 states that such patients ". . . require health-promoting lifestyle modifications to prevent CVD."[1] These lifestyle modifications include weight loss (if overweight); increased physical

activity; increased intake of whole grains, fruits, and vegetables; and moderation of alcohol intake. Such lifestyle modifications are of course advisable for all individuals regardless of BP status. The assumption is that patients with prehypertension would receive more intensive, or targeted, advice. The previous JNC 6 report, published in 1997, defined the range of BP 130 to 139 mm Hg systolic or 85 to 89 mm Hg diastolic as high-normal.[2] BPs below this range, including those 120 to 129 mm Hg systolic and 80 to 84 mm Hg diastolic, were considered normal. JNC 7 has in effect, expanded the number of individuals considered abnormal.

Normal BP is now defined as systolic BP less than 120 mm Hg and a diastolic BP less than 80 mm Hg.[1] A recent population-based study demonstrated that 41.8% of US adults have normal BP.[3] However, this proportion may not reflect the proportion of patients with normal BP in the family medicine office. The purposes of this study were to estimate (1) the proportion of adults in a family medicine practice who actually have normal BP and describe characteristics of such patients; and (2) the proportions of adult patients in a family medicine practice who have prehypertension and hypertension.

Methods
Setting and Population
The University of North Carolina at Chapel Hill Family Medicine Center is a stand-alone facility that provides comprehensive primary care to a wide variety of patients. Over 20 board-certified family physicians as well as 24 family medicine residents and 3 nurse practitioners regularly see patients in this clinic. Based on administrative data, over 200 patients of all ages are seen per day; 65% are female. Approximately 30% are identified as African American and 2% as Hispanic. Twelve percent are insured by Medicaid and 23% by Medicare. Among all patient visits, benign essential hypertension is the most frequently coded diagnosis. As is customary in family medicine offices, patients presenting for a clinic visit undergo a set of vital signs measurements (including BP) after their check-in but before their visit with their health care provider. Patients are seated and positioned as recommended by JNC 7.[1] Measurements are then taken using an automatic oscillometric device and recorded in the electronic medical record by medical assistants, nursing assistants, licensed practical nurses or registered nurses.

Sample
Using 40% as the proportion of subjects expected to have normal BP, 639 subjects would allow estimation of the outcome in the study population with a 99% CI that is ±5, based on the following formula: $N = 4z_\alpha^2 P(1-P)/W^2$, where N represents the total subjects required, z_α is the standard normal deviate, P represents the expected proportion, and W the width of the CI.[4]

To derive a sample of this size, one clinic day from each of the 5 months preceding the study was randomly selected. Clinic days could have been any day of the work week (Monday through Friday) excluding holidays during the month. Using the university's electronic medical record (EMR) system, the complete list of patients seen on each of the 5 days was generated and printed. The EMR was then used to sequentially review the demographics of each potential subject followed by their vital signs notation, problem list, medication list, and clinic note (if needed) to extract data. Individuals younger than 18 years or pregnant were excluded. Repeat visits for the same individual if he/she happened to visit the clinic on more than one of the 5 selected days were also excluded.

Variables
Age was divided into 4 categories. Body mass index (BMI) was calculated from weight and height data and divided into 3 categories corresponding to normal BMI (<25 kg/m^2), overweight (25 to 30 kg/m^2), and obese (≥30 kg/m^2). Race/ethnicity information was based on the information contained in the demographic information of the EMR. This information was entered by administrative personnel at the time of patient registration. It could have been obtained by self-report or, if in person, based on the perception of the clerk entering the information. Because of difficulty in obtaining, and poor reliability of, information on smoking status from the EMR, this variable was not included. Hypertension or diabetes mellitus was considered present if documented on the problem list. Problems in this list may be entered manually by clinicians at the time of care, but are also automatically supplemented from billing diagnoses after every visit. A subject was considered to be on antihypertensive medications if any antihypertensive medication was documented on the medication list.

A normal BP measurement was defined as systolic BP less than 120 mm Hg and diastolic BP less

than 80 mm Hg. High BP measurement was defined as either systolic greater than or equal to 140 mm Hg or diastolic greater than or equal to 90 mm Hg. These were based on the single measurement noted in the vital signs notation for the day of the visit. If no BP measurement was noted in the vital signs notation, the clinic note was searched. If the clinic note did not contain a BP measurement, the subject was excluded.

Statistical Analysis

First, basic descriptive statistics, histograms and/or linear trend graphs were used to analyze all variables in the study. Proportions (with 95% CI) of subjects with 1 of the 3 BP diagnoses (normal, prehypertension, hypertension) and proportions within defined BP measurement ranges (normal, prehypertensive, high) were determined. Then, using normal BP (defined above) as the outcome variable, bivariate analysis consisted of analyzing differences in the proportion of subjects having normal BP across strata of demographic variables using χ^2 tests. These analyses were stratified by whether or not subjects had documented hypertension or antihypertensive medication(s). Finally, logistic regression was then used to determine the independent associations with having normal BP. These associations are reported as odds ratios. The statistical software package Stata 8.1 (Stata Corp, College Station, TX) was used for all analyses.

Study Approval

This study was approved by the Committee on the Protection of the Rights of Human Subjects of the Biomedical Institutional Review Board of the University of North Carolina at Chapel Hill.

Results

Sample Characteristics

A total of 633 subjects were included. Most subjects in the sample (Table 1) were 35 years and older (82%), female (63%), and non-Hispanic white (59%) Nearly three fourths were overweight or obese. Over 40% had documented hypertension; 18% had documented diabetes, and 13% in total had both hypertension and diabetes documented. Nearly 46% were taking one or more antihypertensive medications.

Table 1. Sample Characteristics (n = 633)

Characteristic	Mean (SD)	Percentage (95% CI)
Systolic BP (mm Hg)	132 (20)	
Diastolic BP (mm Hg)	77 (11)	
Age (years)	50.5 (17)	
Age group		
18–34		18.0 (15.0–21.0)
35–49		32.5 (28.9–36.2)
50–64		27.8 (24.3–31.3)
≥65		21.6 (18.4–24.9)
Sex		
Female		62.6 (58.8–66.3)
Male		37.4 (33.7–41.2)
Race/ethnicity		
Black		32.9 (29.2–36.5)
White		59.1 (55.2–62.9)
Hispanic		2.1 (0.9–3.2)
Asian		3.0 (1.7–4.3)
Other		3.0 (1.7–4.3)
BMI (kg/m²)	29.5 (8.1)	
BMI (kg/m²) category		
<25		28.9 (25.4–32.5)
25–30		30.3 (26.7–33.9)
≥30		40.8 (36.9–44.6)
Documented health conditions		
Hypertension		41.1 (37.2–44.9)
Diabetes		18.2 (15.2–21.2)
Hypertension and diabetes		13.1 (10.5–15.7)
On BP medication(s)		45.7 (41.8–49.5)

BMI, body mass index.

Percentage of Subjects Not Normal with Regard to a BP Diagnosis

When defining the abnormal diagnostic category as including adult patients with previously documented hypertension, those on antihypertensive medication(s), or those with a measurement on the day of visit in the prehypertensive or hypertensive range, only 20.9% (95% CI, 17.7–24.0%) of those in this sample had normal BP (Table 2). Over 58% of all adult patients had a diagnosis of hypertension, were receiving antihypertensive medication(s), or had a BP in the hypertensive range (≥140/90 mm Hg) on the day of their visit. Over one fifth (20.5%, 95% CI, 17.4%–23.7%) had prehypertension.

Percentage of Subjects in Each BP Range

Among the entire sample (n = 633), 71.4% (95% CI, 67.9–74.9%) had a BP measurement on the day of visit that was either in the prehypertensive or

Table 2. Percentage (95% CI) of Patients in Each BP Diagnosis Category (n = 633)

BP Diagnosis	Percentage (95% CI)
Normal*	20.9 (17.7–24.0)
Prehypertension†	20.5 (17.4–23.7)
Hypertension‡	58.6 (54.8–62.5)

* No documentation of hypertension diagnosis or antihypertensive medications and normal BP on day of visit.
† No documentation of hypertension diagnosis or antihypertensive medications and BP 120 to 139 mm Hg systolic or 80 to 89 mm Hg diastolic on day of visit (with neither in the hypertensive range).
‡ Documentation of hypertension diagnosis or antihypertensive medications or BP on day of visit ≥ 140 mm Hg systolic or ≥ 90 mm Hg diastolic.

hypertensive range (Table 3). Just over one quarter (28.6%, 95% CI 25.1–32.1%) had a normal BP measurement, that is, a BP less than 120/80 mm Hg. Among subjects with no documented diagnosis of hypertension or antihypertensive medications, 19.4% (95% CI, 15.1–23.7%) had a high (hypertensive) BP measurement, and another 40% (95% CI, 34.6–45.4%) had a measurement in the prehypertensive range. Thus, only 40.6% (95% CI, 35.2–46.0%) of those without documented hypertension or pharmacologically influenced BP had a normal BP measurement. Among subjects with documented hypertension or on one or more antihypertensive medications, 15.9% had a normal BP. Approximately one third (32.1%, 95% CI, 26.9–37.4%) have presumably been treated to the prehypertensive range, and over half (52.0%, 95% CI, 46.3–57.6%) seem to not be at goal BP. That is, their BP is still in the hypertensive range.

Associations with Having a Normal BP
In bivariate analyses (Table 4) among subjects with no documented diagnosis of hypertension or antihypertensive medications, younger age, female sex, white race, and lower BMI were associated with having a normal BP. Only 30% of those 65 years and older had a normal BP, compared with 52% of those 18 to 34 years of age. Half of females had a normal BP, compared with only 1 of 4 males. Similarly, 43% of white patients had a normal BP compared with 28% of black patients. Only one third of overweight/obese patients had a normal BP, compared with half of those with BMI less than 25 kg/m^2. When adjusting for the demographic characteristics as well as BMI, hypertension diagnosis, and antihypertensive medications (Table 5), the associations with younger age, female sex, white race, and lower BMI remained. The strongest factors independently associated with a normal BP were young age (OR 3.2, 95% CI 1.6 to 6.5, for age 18 to 34) and normal BMI (OR 1.9, 95% CI 1.2 to 3.0, for BMI <25).

Among subjects with documented hypertension or on one or more anti-hypertensive medications, there were no statistically significant differences in the proportion having a normal BP based on the characteristics included in the study (Table 4).

Discussion
In terms of BP measurement, the vast majority of adult patients seen in this family medicine population were not normal. In fact, on a given day, 3 to 4 of every 5 adult patients had a BP measurement in either the prehypertensive or hypertensive range. In terms of diagnoses, 79.1% of all adult family medicine patients in this sample had either prehypertension or hypertension. This represents an approximately 21% higher proportion than that seen in the general population of US adults based on 1999 to 2000 National Health and Nutrition Examination Survey (NHANES) data.[3] This difference probably reflects, at least in part, the higher proportion of illness expected in a clinic population, compared with the general population.

Table 3. Percentage (95% CI) of Patients in Each BP Measurement Range on Day of Visit, Stratified by Hypertension Diagnosis/Treatment Status

BP Measurement	Entire Sample (n = 633)	No Diagnosis of Hypertension or Antihypertensive Medications (n = 325)	Diagnosed with Hypertension or on Antihypertensive Medications (n = 308)
Normal (<120/80 mm Hg)	28.6 (25.1–32.1)	40.6 (35.2–46.0)	15.9 (11.8–20.0)
Prehypertensive (120 to 139/80 to 89 mm Hg)	36.2 (32.4–39.9)	40.0 (34.6–45.4)	32.1 (26.9–37.4)
Hypertensive (≥ 140/90 mm Hg)	35.2 (31.5–39.0)	19.4 (15.1–23.7)	52.0 (46.3–57.6)

Table 4. Bivariate Associations with Normal BP Stratified by Hypertension Diagnosis/Medications Status*

Characteristic	No Diagnosis of Hypertension or Antihypertensive Medications (n = 325)			Diagnosed with Hypertension or on Antihypertensive Medications (n = 308)		
	N	Percentage	P Value	N	Percentage	P Value
Age						
18–34	94	52.1	.002	20	25.0	.233
35–49	142	43.0		64	15.6	
50–64	62	22.6		114	19.3	
≥65	27	29.6		110	10.9	
Sex						
Female	203	49.8	<.001	193	14.0	.233
Male	122	25.4		115	19.1	
Race/ethnicity						
White	203	43.4	.056	171	19.3	.399
Hispanic	12	33.3		1	-	
Black	78	28.2		130	12.3	
BMI						
<25	125	51.2	.008	58	20.7	.54
25–30	113	32.7		79	15.2	
≥30	87	35.6		171	14.6	

* N represents the total number of individuals within each category; percentage represents the proportion with normal BP as defined as <120 mm Hg systolic and <80 mm Hg diastolic; Values of P are based on χ^2 test of difference in proportions within categories. BMI, body mass index.

Among those who had an abnormal measurement, approximately half were in the hypertensive

Table 5. Independent Associations with Normal BP (n = 633)*

Characteristic	OR	95% CI
Age		
18–34	3.2	1.6–6.5
35–49	2.4	1.3–4.5
50–64	1.4	0.74–2.6
≥65	Referent	
Sex		
Female	1.6	1.1–2.5
Male	Referent	
Race/ethnicity		
White	1.8	1.1–2.8
Hispanic	0.72	0.15–3.4
Black	Referent	
BMI (kg/m²)		
<25	1.9	1.2–3.0
25–30	1.2	0.73–2.0
≥30	Referent	
Hypertension diagnosis	0.38	0.19–0.71
On BP medication(s)	1.1	0.62–2.2

* Based on logistic regression adjusted for all other characteristics in table. BMI, body mass index.

range and half were in the prehypertensive range. When stratified by hypertensive diagnosis and/or medications, almost 60% of patients in this family medicine clinic population with no prior diagnosis of hypertension or on antihypertensive medications had a BP measurement that was not normal, and 19.4% may have yet undetected or untreated hypertension (ie, BP ≥140/90 mm Hg). However, it is not known who among this 20% had a repeat measurement in the clinic that was actually less than 140/90 mm Hg, or who might be undergoing repeat evaluations of their elevated BP to establish a diagnosis, or who is being evaluated for possible "white-coat" hypertension.

Among patients known (documented) to have hypertension or receiving antihypertensive medications, 52% are apparently uncontrolled, ie, have a BP greater than 140 mm Hg systolic or greater than 90 mm Hg diastolic. Again, this percentage is based solely on one measurement and does not take into account factors such as a repeat measurement by the clinician or possible "white-coat" effect. However, it also does not take into account the possibility of masked hypertension[5] or that goal BP for some groups (eg, diabetics) is actually even lower.[1] Although this percentage is less than the

69% of patients in the general US population who do not have their hypertension under control[6] and is close to the Healthy People 2010 population goal of 50%,[7] it still leaves much room for improvement.

Certainly, it is not common for people 65 years and older to have a BP in the normal range, and these data affirm this: 30% of those 65 years and older with no documented hypertension or antihypertensive medications, and only 11% of those 65 years and older with documented hypertension or antihypertensive medications, had a normal BP.

The findings that younger age and lower BMI are associated with having a normal BP are not surprising. In this study, the bivariate associations with normal BP do not hold true among those who have documented hypertension or antihypertensive medications. This suggests that patients are equally unlikely to be treated to—or it is equally unlikely to achieve—a BP goal that is as aggressive as normal once they have reached the treatment threshold.

As anticipated, many patients' BPs fall within the prehypertensive range. Among patients documented to have hypertension or receiving antihypertensive medications, 32% had a BP measurement in the prehypertensive range. This is certainly reasonable given that the goal BP in those at highest cardiovascular risk is still within the prehypertensive range. Among those with no prior diagnosis of hypertension or on antihypertensive medications, 40% had BPs considered prehypertensive. These are the patients who are recommended to receive counseling regarding lifestyle recommendations to lower their risk of progression to hypertension. This represents a substantial number of family medicine patients. Such counseling also requires a large amount of additional time in an already busy setting, and the outcomes are uncertain. It will remain a challenge for clinicians to develop the skills needed to effectively counsel these at-risk patients, while at the same time performing better case-finding for undiagnosed hypertensives as well as more intensive treatment for those already under partial treatment.

Limitations

The diagnosis codes used in this study were based on documentation in the EMR. It is possible that a patient could have had a diagnosis of hypertension that was not recorded in the record by the clinician. However, diagnoses from billing codes are automatically added to this list, so this is likely to be a minor issue. Medication usage was also based on documentation in the EMR. Medications not listed in the EMR would not have been noted. It is also recognized that some antihypertensives are used to treat conditions other than hypertension. However, the effects of these limitations on the estimates are likely to be minimal.

BP measurements in this study were based on the measurement taken by the nurses or medical assistants at the vital signs station. Some of these measurements may have been falsely high (eg, if too small a cuff was used) or falsely low (eg, if too large a cuff was used). However, the means in a large clinic sample are unlikely to be significantly affected. In addition, it is recognized that a diagnosis of prehypertension should be based on at least 2 BP readings from at least 2 separate office visits.[1]

This study was conducted in one large clinic in the Southeastern United States with a primary care population that may not be representative of other clinics or locations. Thus, the results may not be generalizable. This may be particularly true for clinics that have a larger elderly population, relatively few younger adults, or a lower proportion of women. However, such populations would probably have an even higher proportion of patients with abnormal BP. The results also may not be generalizable to clinic populations with a lower proportion of black patients. Estimates of proportions of patients with abnormal BP in such a population might be lower than seen in this study.

Conclusions

Only one of every 5 nonpregnant, adult patients seen in a family medicine setting has BP that would be considered normal by the JNC 7 definition. Such patients are more likely to be young and not overweight or obese. They are also more likely to be female and white. The remaining 80% of adult patients have either hypertension or prehypertension. Among patients with hypertension, over half have BP measurements that are not at goal. Although current guidelines suggest more aggressive approaches (ie, counseling) to those with prehypertension, improving BP control among those who have already crossed the treatment threshold should remain a priority. In terms of effectiveness of clinical interventions, the number of patients

with established hypertension who need to be treated (ie, number needed to treat) to achieve benefit will be exceedingly lower than the number of patients with prehypertension who need to be counseled to achieve benefit. Given that nearly half of patients with established hypertension may be undertreated, truly expanding the number of patients for whom the clinician should intervene should be done with care. If prehypertension needs to be addressed in the clinical setting, clinicians will probably need to seek innovative ways to effectively counsel such patients, perhaps through group visits or use of allied health care team members. Alternatively, the best method to counsel people about prehypertension might be outside the clinic setting.

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