

**Cardiovascular Disease Risk Factors and Blood
Pressure Control in Ambulatory Care Visits
to Physician Offices in the U.S.**

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Dedication

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Abstract

Background: Cardiovascular disease is the leading cause of mortality in the U.S. Risk factors identified for coronary artery disease, cerebrovascular disease, and kidney disease include uncontrolled blood pressure, diabetes, renal disease, hyperlipidemia, obesity, and tobacco use. The threshold for pharmacologic treatment of hypertension in patients with diabetes or chronic kidney disease is $\geq 130/80$ mmHg. It may be of benefit to extend these criteria to individuals who have other cardiovascular disease risk factors and no diagnosis of hypertension. Blood pressure recommendations in this population have largely been unstudied. This study investigates blood pressure control in this non-hypertensive population.

Methods: We analyzed 2006 National Ambulatory Medical Care Survey (NAMCS) data to determine blood pressure control at physician office visits in the U.S. among patients with cardiovascular disease risk factors and no diagnosis of hypertension. Physician office visits with a documented diagnosis of hypertension were excluded from our study. Characteristics of the non-hypertensive population were identified and were classified by blood pressure above or below 140/90 mmHg. Cardiovascular disease risk factors examined were diabetes,

renal disease, hyperlipidemia, obesity, tobacco use, males >55 years, and females >65 years. This population was then divided into two groups, those with blood pressure above or below 130/80 mmHg.

Results: We found 22,744 records (77.4% of visits) with no diagnosis of hypertension out of 29,392 total records, with 43.2% of the non-hypertensive population having BP <140/90 mmHg. Males fulfilled criteria for hypertension ($\geq 140/90$ mmHg) more frequently than females (63.5% vs. 52.3%, P -value <.001). Patients were mostly younger than 65 years. Males >55 years was the most prevalent CVD risk factor, with 79.2% of these with BP $\geq 130/80$ mmHg. Second most prevalent risk factor was tobacco use at 10.1% of non-hypertensive visits, and BP was $\geq 130/80$ mmHg in 63.6% of these visits.

Hyperlipidemia in 5.6% of total visits, with BP $\geq 130/80$ mmHg in 60.5%. Obesity was documented in 5.5% of non-hypertensive population, with BP $\geq 130/80$ mmHg in 60.0%. Visits with one risk factor with BP $\geq 130/80$ mmHg were found in 22.8% of our non-hypertensive study population.

Conclusions: 56.8 % of those without a diagnosis of hypertension had elevated blood pressure recorded at their physician visit. BP control rate in our non-hypertensive population was 43.2%, surprisingly

similar to hypertensive populations and demonstrating the need for improvement in awareness and onset of treatment. There were more patient office visits with BP \geq 130/80 mmHg in each group of cardiovascular disease risk factors when compared to BP <130/80 mmHg. At least one cardiovascular disease risk factor and BP \geq 130/80 mmHg was present in 22.8% of the non-hypertensive population. A greater percentage of patients with obesity, hyperlipidemia, tobacco use, male >55 years, or female >65 years had BP \geq 130/80 mmHg when compared to patients with diabetes or renal disease. It may be of benefit to extend the threshold for pharmacologic treatment of hypertension to \geq 130/80 mmHg for patients with these additional cardiovascular disease risk factors. More studies are needed that evaluate blood pressure goals amongst non-hypertensive patients with multiple cardiovascular disease risk factors.

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Introduction

Background

Cardiovascular disease is the leading cause of mortality in the United States (1). Hypertension is associated with an elevated risk for coronary artery disease, cerebrovascular disease, and kidney disease (2). Antihypertensive therapy and lifestyle modifications have been demonstrated to significantly decrease major cardiovascular events (3). Approximately one-third of the United States population has hypertension, which include both diagnosed and undiagnosed individuals (2). Approximately two-thirds of these individuals are untreated or not achieving optimal control (2).

According to the Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC-7) hypertension is defined as a systolic blood pressure above 140 mmHg or a diastolic above 90 mmHg (2). If blood pressure does not fall into the recommended range after appropriate lifestyle modifications have been made, antihypertensive pharmacologic therapy is indicated in order to achieve optimal control. According to an analysis of a 2003 and 2004 national dataset, 44% of individuals with diagnosed hypertension are achieving recommended control (4).

The National Health and Nutrition Examination Survey (NHANES) 1999-2000 reported hypertensive individuals controlled (<140/90 mmHg) in 34% of cases (5). A more recent 2007-2008 NHANES analysis demonstrated hypertension control rates of 50%, meeting the goal recommended by *Healthy People 2010* (6, 7). There is still much room for improvement.

In addition to hypertension, there are a variety of risk factors for cardiovascular disease. According to JNC-7, some of the established risk factors include cigarette smoking, obesity (body mass index ≥ 30 kg/m²), physical inactivity, dyslipidemia, diabetes mellitus, microalbuminuria or estimated GFR <60 mL/min, age >55 years for men or >65 years for women, and family history of premature cardiovascular disease (men <55 years or women <65 years) (2). Antihypertensive therapy is an essential tool utilized to prevent cardiovascular events, such as a myocardial infarction or stroke. The current recommendations suggest starting pharmacologic therapy in those patients with multiple blood pressure measurements above 140/90 mmHg (2).

Multiple drug trials have demonstrated the benefit of hypertension control in patients with diabetes for preventing

cardiovascular disease and minimizing the progression of diabetic nephropathy (8, 9, 10). In addition, good blood pressure control in patients with chronic kidney disease protects against worsening renal function and cardiovascular disease (14). The recommended blood pressure goal, and standard of care, for patients with diabetes or chronic kidney disease is less than 130/80 mmHg (2, 11, 12, 13).

Significance

The current criteria, which simply utilizes a blood pressure cutoff for initiating antihypertensives, does not take into account a patient's cumulative risk for cardiovascular disease. In addition to an office blood pressure measurement, it has been suggested that a patient's cardiovascular risk be assessed to identify the need for pharmacologic therapy (14). Antihypertensive therapy could be indicated in patients that do not necessarily meet the current definition of hypertension. For example, individuals with one or more cardiovascular disease risk factors without documented hypertension and considered normotensive according to the current criteria may decrease their risk for a cardiovascular event with the initiation of antihypertensive therapy. Randomized controlled studies assessing blood pressure goals in this patient population are lacking (15).

As described above, patients with diabetes or chronic kidney disease are recommended to maintain blood pressure below 130/80 mmHg. It may be of benefit to extend the threshold for antihypertensive therapy of 130/80 mmHg to individuals who have the following cardiovascular disease risk factors: obesity, tobacco use, hyperlipidemia, males >55 years, and females >65 years.

Aims/Goals/Hypothesis

Using the 2006 National Ambulatory Medical Care Survey (NAMCS) data, published by the Centers of Disease Control and Prevention in 2008, we investigated blood pressure control at physician office visits in the non-hypertensive population (16, 17). We performed analyses of this dataset to evaluate blood pressure control rates with documented cardiovascular disease risk factors. The risk factors included in the NAMCS data are age, smoking status, obesity, diabetes, hyperlipidemia, and renal disease (16, 17). Risk factors not included in the dataset are family history of early cardiovascular disease and physical inactivity (16, 17).

We hypothesized that in the non-hypertensive population with one or more cardiovascular disease risk factors there would be a greater number of patient office visits with blood pressure

measurements $\geq 130/80$ mmHg. Additionally, we hypothesized that the non-hypertensive population would have blood pressure control rates higher than national percentages which include hypertensive individuals. Given the lack of research evaluating blood pressure control in this non-hypertensive patient population our cross-sectional study provides preliminary analyses.

Research Materials and Methods

The 2006 NAMCS data was published by the CDC in August 2008, and is available for the public to utilize for research purposes. This national survey has been conducted annually since 1989, completed by nonfederal, office-based physicians in the United States. The data represents a random sampling of patient visits to physicians over a one week period. Data includes patients' symptoms, physicians' diagnoses, and medications ordered or provided. It also includes demographic characteristics of patients, services provided, information on diagnostic procedures and patient management, as well as planned future treatment. All collected data has been de-identified, and no provider or patient information is included (16, 17).

The NAMCS data is accessible via the National Center for Health Statistics (NCHS) website, <http://www.cdc.gov/nchs/ahcd.htm> (16, 17, 18). Using the downloadable 2006 NAMCS dataset we studied the aforementioned cardiovascular disease risk factors in relation to blood pressure control as documented in the patient record form. The publicly available data was loaded into SQL server tables. Microsoft Access 2007 was then utilized to link to those tables. SQL queries were then written and performed according to the criteria as outlined here.

Patient visits with a documented diagnosis of hypertension were excluded from our study. These visits were identified because the physician had checked “hypertension” under diagnosis for visit, or the diagnosis was coded as ICD-9-CM 401-405.

Cardiovascular disease risk factors including age, tobacco use, obesity, diabetes, hyperlipidemia, and renal disease were identified using the following methods. The survey includes date of birth to determine age. Tobacco use is identified if “current tobacco use”, was checked, the reason for the visit was “smoking problems”, or the diagnosis for the visit was coded as ICD-9-CM 305.1 for tobacco use disorder. Obesity was defined using ICD-9-CM 278, or diagnosis for

visit “obesity”. (Height and weight was provided on survey for potential BMI calculation, although data completion for height value was found to be incomplete in the majority of data records.) Diabetes was defined using ICD-9-CM 250, reason for visit “diabetes mellitus”, or checking “diabetes” under diagnosis for visit. Hyperlipidemia was identified using ICD-9-CM 272.0-272.2 or by checking “hyperlipidemia” under diagnosis for visit. Renal disease was defined using ICD-9-CM 585.3 (chronic kidney disease, stage III), 585.4 (chronic kidney disease, stage IV), 585.5 (chronic kidney disease, stage V), 585.6 (end stage renal disease), 585.9 (chronic kidney disease, unspecified), or 586.0 (renal failure, unspecified), reason for visit “kidney dialysis,” or by checking “chronic renal failure” under diagnosis for visit. Blood pressure measurements are included in the vital signs section of the survey, with both systolic and diastolic measurements.

Using this dataset we looked at blood pressure control in physician office visits with no diagnosis of hypertension. We further characterized this group by sex, age, and ethnicity. Our second analysis included cardiovascular disease risk factors as described above in patients without a diagnosis of hypertension. This group was classified according to blood pressure measurements, $\geq 130/80$ and

<130/80. In addition, we performed analyses for patients with one to five risk factors, covering all appropriate combinations. These were classified according to blood pressure measurements $\geq 130/80$ or <130/80.

Statistical analyses performed included the use of contingency tables and chi-square tests for the specified comparisons as outlined below. These include male versus female, Hispanic versus non-Hispanic, and age as described in the characteristics of our study population. Additionally, we performed comparisons of the number of cardiovascular disease risk factors present in our study population to include one versus two risk factors, one versus three risk factors, etc. as demonstrated below.

Results

As documented in the National Ambulatory Medical Care Survey, 2006 Summary, 29,392 patient record forms (PRFs) were completed (16). Hypertension related visits comprised 22.4% of visits (16). According to our criteria for hypertension as described above, we found 22,744 PRFs (table 1) without a diagnosis of hypertension, 77.4% of total visits for 2006. Despite the fact that hypertension was not

reported, 56.8% of our study population had blood pressure measurements ≥ 140 mmHg systolic or ≥ 90 mmHg diastolic, meeting the criteria for hypertension. We found 43.2% of patients with adequately controlled blood pressures measuring $< 140/90$ mmHg. Amongst further classification of this population separated by sex, ethnicity and age we found more than half of visits in each sub-group to meet criteria for hypertension, (blood pressures ≥ 140 mmHg systolic or ≥ 90 mmHg diastolic) with a range from 52.3% (females) up to 64.1% (age ≥ 65).

Females comprised the majority of the population without a reported diagnosis of hypertension at 59.9% of patient visits (table 2). A higher proportion of males (63.5%) without a reported diagnosis of hypertension were found to meet the criteria for hypertension (according to documented blood pressure) than females, (52.3%)(table 1). The non-Hispanic population comprised 85.6% of visits without a reported diagnosis of hypertension (table 2). Age distribution demonstrated patients without a reported diagnosis of hypertension were more likely to be younger than 65, comprising 41.2% of visits for < 35 years, 40.5% of visits for 35 to 64 years and 18.4% of visits for ≥ 65 years.

Further classifying our non-hypertensive population by cardiovascular disease risk factors as previously described (table 3, table 4, and table 5) we found that males >55 years was the most prevalent risk factor, found in 12.5% of all non-hypertensive visits, with 79.2% of these having blood pressure $\geq 130/80$ mmHg. The second most prevalent risk factor was tobacco use at 10.1% of non-hypertensive visits, with blood pressure $\geq 130/80$ mmHg in 63.6% of these visits. Diabetes was present in 7.6% of all visits, and 57.0% of those with diabetes had blood pressure $\geq 130/80$ mmHg. Obese individuals comprised 5.5% of the non-hypertensive population, with blood pressure $\geq 130/80$ mmHg in 60.0% of this population. Reported hyperlipidemia was found in 5.6% of all visits, with blood pressure $\geq 130/80$ mmHg in 60.5% of this population. Renal disease was the least prevalent risk factor in our non-hypertensive population at 0.8% of visits, with blood pressure $\geq 130/80$ mmHg found in 57.7% of visits. The final cardiovascular disease risk factor that we examined was females >65 years which comprised 9.6% of all visits, and was found to be the largest group with blood pressure $\geq 130/80$ mmHg at 80.2%.

Patient visits with multiple cardiovascular disease risk factors were classified by blood pressure measurements (table 4 and table 5).

Visits with a minimum of one documented risk factor comprised 32.4% of non-hypertensive related visits, with blood pressure $\geq 130/80$ mmHg found in 70.3% of this subset. Two risk factors were present in 7.1% of visits, and blood pressure $\geq 130/80$ mmHg was found in 68.0% of this population. Three risk factors were found in 1.4% of visits, with blood pressure $\geq 130/80$ mmHg found in 62.6% of visits. Four risk factors comprised only 0.2% of visits without a diagnosis of hypertension, and blood pressure $\geq 130/80$ mmHg was found in 50.0% of this group. We only found one PRF out of 22,744 with five risk factors and no diagnosed hypertension.

Discussion

Our analysis demonstrates a substantial number of visits (56.8% with blood pressure ≥ 140 mmHg systolic or ≥ 90 mmHg diastolic) without a documented diagnosis of hypertension, who in fact meet the current criteria, as per JNC-7 (2). Reasons for this finding may be explained by the fact that these blood pressures may have been the first documented elevated measurement. As per JNC-7, hypertension is officially diagnosed with two or more accurate measurements $\geq 140/90$ mmHg (2). NAMCS data captures only a single physician

office visit making it difficult to ascertain if the documented elevation had been found in previous visits. Other explanations may include the following: the physician decided not to address the elevated blood pressure at that particular visit, the elevated blood pressure was overlooked by the clinician, or a previous diagnosis of hypertension was mistakenly not included in the survey section 5b, “provider’s diagnosis for this visit”.

Given the fact that our population is comprised of unreported or undiagnosed hypertension, blood pressure control rates were found to be much worse than national estimates, which include patients with diagnosed hypertension. NHANES 2007-2008 demonstrated 50.1% of hypertensive patients to have controlled blood pressure (<140/90 mmHg) (6). Surprisingly, our study, which was comprised of patient visits without a reported diagnosis of hypertension, found only 43.2% to have adequately controlled blood pressure. While this is similar to control rates for NHANES 2005-2006, which was 44.8%, we anticipated better control rates in our non-hypertensive population (6).

Classification by sex demonstrates men to have more poorly controlled blood pressure than women (63.5% vs. 52.3% respectively, p-value <.001). This is consistent with prior studies that suggest men to

be less aware of hypertension, and therefore more often undiagnosed than women (6). Women are more likely to seek medical care than men (8). This may help to explain men's lack of awareness of hypertension. Another reason for the high percentage of males with uncontrolled blood pressure may be that the data represents a greater portion of initial visits by males to a physician office, with the first evidence of elevated blood pressure. Subsequent visits may confirm the elevated blood pressure and ultimately result in a diagnosis of hypertension and the onset of treatment.

Our analysis of ethnicity demonstrates Hispanics to have marginally better blood pressure control rates than non-Hispanics, at 47.5% and 42.5% respectively (p-value <.001). Our findings are not consistent with NHANES 2007-2008, which demonstrates Hispanics to be less aware of hypertension and more poorly controlled when compared to non-Hispanics (6).

As described in previous studies blood pressures tends to increase with age (2, 6). In the NHANES 2007-2008 study patients older than 60 years of age were more aware of hypertension and more often treated, although this age group was less often controlled when compared to younger patients (6). Consistent with previous studies,

hypertension control rates for patients ≥ 65 years in our non-hypertensive population were amongst the worst, at 35.9% with blood pressures $< 140/90$ mmHg.

According to the current recommendations for blood pressure control for diabetes and chronic kidney disease of $< 130/80$ mmHg, our analysis demonstrates a significant percentage of these patients without a diagnosis of hypertension to have uncontrolled blood pressure, 57.0% and 57.7% respectively. This leaves room for much improvement. Hypertension was not diagnosed at the time of these blood pressure readings. This may be due to the clinician overlooking a marginally elevated measurement in the majority of visits. In an analysis of 2003-2004 NAMCS data by Fang and colleagues, blood pressure control rates for diabetics were 22.4% (4). As mentioned, our study found control rates for diabetics to be 43.0%, much better than this previous analysis; however, their analysis included diabetics with a diagnosis of hypertension. Our analysis excluded those with a diagnosis of hypertension which may explain the better control rates. Chronic kidney disease was not assessed in the study by Fang. Regardless of the comparison to prior studies, both groups in our

analysis demonstrate poor hypertension control rates as per current recommendations.

Our hypothesis of finding a greater number of patient office visits with blood pressure $\geq 130/80$ mmHg in the non-hypertensive population with one or more cardiovascular disease risk factors was verified (table 3). For visits with documented obesity, hyperlipidemia, or tobacco use, uncontrolled blood pressure as per our proposed criteria of $\geq 130/80$ mmHg was found in greater than 60% of visits in each group. Females >65 years were the most uncontrolled at 80.2%, while males >55 years were uncontrolled in 79.2% of visits. Proposed revisions to hypertension guidelines as mentioned here may indicate the initiation of antihypertensive medications in a considerable number of patients.

Our analysis looking at multiple cardiovascular disease risk factors demonstrates significant results. We found 22.8% of our non-hypertensive population to have at least one cardiovascular disease risk factor (diabetes, obesity, hyperlipidemia, tobacco use, renal disease, male >55 years, or female >65 years) with blood pressure ≥ 130 systolic or ≥ 80 diastolic. This represents 5,175 visits of which initiating antihypertensives would be indicated according to our

revised criteria. Those visits with at least two risk factors and blood pressure $\geq 130/80$ comprised 4.8% of total visits. Three risk factors comprised 0.9% of visits, and four risk factors comprised 0.1%. This downward trend probably represents that hypertension is more likely to be diagnosed as a patient has an increasing number of cardiovascular disease risk factors.

Limitations to our study include the lack of comparative analyses to the hypertensive population. Our study was intended to focus on physician office visits without a diagnosis of hypertension, and to assess blood pressure control rates. It would have been useful to have data from the hypertensive group for comparison purposes.

The method by which the blood pressure measurement was obtained at each visit was not standardized or verified. Per JNC-7 the correct method for blood pressure measurement is to take the average of two blood pressures on one arm after the patient has been seated quietly for five minutes (2). It is unlikely that this was performed at each study site.

NAMCS data is limited for a number of reasons. The data represents physician office visits, not complete patient analyses over time. The patient population represented here are those seeking

medical care, and thus do not represent the entire U.S. population. The data is not longitudinal in nature, making it difficult in our analyses to determine if the elevated blood pressures were the first documented evidence of hypertension. Per JNC-7 the diagnosis of hypertension requires “the average of two or more properly measured, seated, BP readings on each of two or more office visits” (2). It would be useful to determine if hypertension was in fact diagnosed at a subsequent visit, or if an elevated measurement had been documented previously.

Other limitations to our study include that our analyses did not assess pharmacologic therapy and blood pressure control. It is unknown whether our study population includes those already on antihypertensive medications. We could have excluded these individuals from our study and further validated our results.

Future Directions

Given the lack of studies addressing blood pressure goals amongst non-hypertensive patients with multiple cardiovascular disease risk factors, our study demonstrates the need for additional analyses. Randomized controlled studies evaluating the use of

antihypertensives in this patient population with marginally elevated blood pressures ($\geq 130/80$ mmHg) would provide the most useful results. Our study demonstrates a large population that would meet these criteria. Patients that use tobacco, are obese, or have hyperlipidemia would most likely be affected by these studies, as they comprise the majority of this population.

Additional studies that would prove useful may also include evaluations of the timing of diagnosis of hypertension at physician offices in the U.S. Our study demonstrates a significant lack of an official diagnosis of hypertension at a single visit despite meeting established criteria. A longitudinal analysis would prove extremely useful in assessing the timing of a hypertension diagnosis. This may be a better assessment of our study population and provide valuable data concerning the effectiveness of interventions.

If new data were obtained we would redesign the survey to be more specific for our intended analyses. Blood pressure measurements would be standardized. The reporting of patient specific data would be more accurate to avoid unreported risk factors. For example, height and weight would be documented for every patient allowing an accurate BMI calculation and subsequent reporting of obesity.

Additionally, our data would be longitudinal in nature, thus allowing us to follow patients over time.

Conclusions

It has been demonstrated that the awareness, treatment, and control of hypertension in the U.S. has improved over the last decade (6, 19). It has been suggested that this may be explained by increased availability and tolerability of antihypertensives, increased use of electronic systems providing feedback reminders to both patients and clinicians, and the increasing use of nonphysician healthcare professionals in the management team (20). Despite the improved statistics, early diagnosis and treatment of hypertension are important for the prevention of cardiovascular events. While our study does not report blood pressure control rates meeting the *Healthy People 2010* goal of 50%, the suggested explanations for improved awareness, treatment, and control may very well be reflected in future analyses of NAMCS data.

If guidelines for antihypertensive therapy included both a cardiovascular disease risk analysis and a blood pressure measurement, many more individuals would meet criteria for

treatment. Our study demonstrates a significant number of physician office visits in the U.S. in 2006 that would meet these revised guidelines for antihypertensive therapy. This would significantly impact healthcare spending, increasing the number of individuals on antihypertensive therapy. This may be viewed as an early intervention to a probable future diagnosis of hypertension in this high risk population. Additionally, this could be a preventive measure for future cardiovascular events, thus decreasing their incidence over time.

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Table 1: Characteristics of physician office visits with no diagnosis of hypertension, NAMCS 2006

Characteristics	Blood pressure Systolic ≥ 140 or Diastolic ≥ 90	Percent	Blood pressure Systolic < 140 and Diastolic < 90	Percent	Totals	P-value*
Number of Visits	12920	56.8%	9824	43.2%	22744	
Male	5787	63.5%	3325	36.5%	9112	<.0001
Female	7133	52.3%	6499	47.7%	13632	
Hispanic	1723	52.5%	1559	47.5%	3282	<.0001
Non-Hispanic	11197	57.5%	8265	42.5%	19462	
Age < 35	5256	56.2%	4104	43.8%	9360	<.0001
Age 35-64	4984	54.1%	4222	45.9%	9206	
Age ≥ 65	2680	64.1%	1498	35.9%	4178	

*values for male vs. female, hispanic vs. non-Hispanic, and age respectively

Table 2: Characteristics of physician office visits with no diagnosis of hypertension by percentage of total study population, NAMCS 2006

Characteristics	Blood pressure Systolic ≥ 140 or Diastolic ≥ 90	Percent of total n=22744	Blood pressure Systolic <140 and Diastolic <90	Percent of total n=22744	Totals	Percent of total n=22744
Male	5787	25.4%	3325	14.6%	9112	40.1%
Female	7133	31.4%	6499	28.6%	13632	59.9%
Hispanic	1723	7.6%	1559	6.9%	3282	14.4%
Non-Hispanic	11197	49.2%	8265	36.3%	19462	85.6%
Age < 35	5256	23.1%	4104	18.0%	9360	41.2%
Age 35-64	4984	21.9%	4222	18.6%	9206	40.5%
Age ≥ 65	2680	11.8%	1498	6.6%	4178	18.4%

Table 3: Cardiovascular disease risk factors in physician office visits with no diagnosis of hypertension, NAMCS 2006

Risk factor	Blood pressure Systolic \geq 130 or Diastolic \geq 80		Blood pressure Systolic <130 and Diastolic <80		Totals
		Percent		Percent	
Diabetes	980	57.0%	740	43.0%	1720
Obesity	750	60.0%	499	40.0%	1249
Hyperlipidemia	773	60.5%	504	39.5%	1277
Tobacco Use	1456	63.6%	833	36.4%	2289
Renal Disease	105	57.7%	77	42.3%	182
Males >55 years old	2245	79.2%	591	20.8%	2836
Females >65 years old	1752	80.2%	432	19.8%	2184

Table 4: Blood pressure control in physician office visits by number of cardiovascular disease risk factors*, NAMCS 2006.

Number of risk factors	Blood pressure Systolic ≥ 130 or Diastolic ≥ 80	Percent	Blood pressure Systolic < 130 and Diastolic < 80	Percent	Totals	P- value**
1 risk factor	5175	70.3%	2185	29.7%	7360	<.0001
2 risk factors	1091	68.0%	514	32.0%	1605	
3 risk factors	204	62.6%	122	37.4%	326	
4 risk factors	23	50.0%	23	50.0%	46	
5 risk factors	0	0.0%	1	100.0%	1	

*cardiovascular disease risk factors include: diabetes, obesity, tobacco use, renal disease, males > 55 and females > 65
 **value for one vs. two risk factors, and one vs. three risk factors, etc.

Table 5: Cardiovascular disease risk factors in physician office visits with no diagnosis of hypertension by percentage of total study population, NAMCS 2006

Risk factor	Blood pressure Systolic ≥ 130 or Diastolic ≥ 80	Percentage of total n=22744	Blood pressure Systolic <130 and Diastolic <80	Percentage of total n=22744	Totals	Percentage of total n=22744
Diabetes	980	4.3%	740	3.3%	1720	7.6%
Obesity	750	3.3%	499	2.2%	1249	5.5%
Hyperlipidemia	773	3.4%	504	2.2%	1277	5.6%
Tobacco Use	1456	6.4%	833	3.7%	2289	10.1%
Renal Disease	105	0.5%	77	0.3%	182	0.8%
Males >55 years old	2245	9.9%	591	2.6%	2836	12.5%
Females >65 years old	1752	7.7%	432	1.9%	2184	9.6%
Number of risk factors						
1 risk factor	5175	22.8%	2185	9.6%	7360	32.4%
2 risk factors	1091	4.8%	514	2.3%	1605	7.1%
3 risk factors	204	0.9%	122	0.5%	326	1.4%
4 risk factors	23	0.1%	23	0.1%	46	0.2%
5 risk factors	0	0.0%	1	0.0%	1	0.0%

Cardiovascular disease risk factors and blood pressure control in ambulatory care visits to physician offices in the U.S.

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Introduction

Cardiovascular disease is the leading cause of mortality in the U.S. Risk factors identified for cardiovascular disease include uncontrolled blood pressure, diabetes, renal dysfunction, obesity, and tobacco use. The best clinical practice for the treatment of hypertension in patients with diabetes or chronic kidney disease is $\geq 130/80$ mmHg. It may be of benefit to extend these criteria to individuals who have other cardiovascular disease risk factors and no diagnosis of hypertension. Blood pressure recommendations in this population have largely been unstudied.

Hypothesis

We hypothesized that in the non-hypertensive population with one or more cardiovascular disease risk factors, there would be a greater number of patient office visits with blood pressure measurements $\geq 130/80$ mmHg. Additionally, we hypothesized that the non-hypertensive population would have a blood pressure control rate higher than national percentages which include hypertensive individuals.

Materials and methods

We analyzed 2006 National Ambulatory Medical Care Survey (NAMCS) data ($n=29,392$ patient record forms) to determine blood pressure control at physician office visits in the U.S. among patients with cardiovascular disease risk factors and no diagnosis of hypertension. Patient record forms with a documented diagnosis of hypertension were excluded from our study ($n=6,648$), leaving 22,744 records for our analyses. Characteristics of the non-hypertensive population were identified and classified by blood pressure above or below 140/90 mmHg.

Cardiovascular disease risk factors included in the survey were diabetes, renal disease, hyperlipidemia, obesity, tobacco use, males >55 years, and females >65 years. This population was then classified by blood pressure above or below 130/80 mmHg. The publicly available data was loaded into SQL server tables. Microsoft Access 2007 was then utilized to link to those tables. SQL queries were written and performed.

Results

Table 1: Characteristics of physician office visits with no diagnosis of hypertension classified by blood pressure above or below 140/90 mmHg, NAMCS 2006.

Characteristics	Blood pressure above or below 140/90 mmHg	Percent of total	Blood pressure above or below 130/80 mmHg	Percent of total	P value*
Number of visits	13920	50.8%	9824	36.3%	22744
Male	5787	63.5%	3325	36.5%	9112
Female	7133	52.3%	6499	47.7%	13632
Hispanic	1725	52.5%	1659	47.5%	3382
Non-Hispanic	11197	57.5%	8565	42.5%	19462
Age ≤ 55	656	39.2%	417	42.8%	1073
Age 56-64	2884	57.6%	4122	48.8%	7006
Age >65	2880	64.1%	1458	36.9%	4338

*Statistical tests for blood pressure in non-hypertensive and hypertensive patients. Table 1: Patients with blood pressure $\geq 140/90$ mmHg comprised the majority of the population, female 56.8% of visits. Patients with blood pressure $\geq 140/90$ mmHg had more office visits amongst all groups. Patients were mostly female, non-Hispanic, and age <65 years.

Figure 1: Cardiovascular disease risk factors in physician office visits with no diagnosis of hypertension, classified by blood pressure above or below 130/80 mmHg.

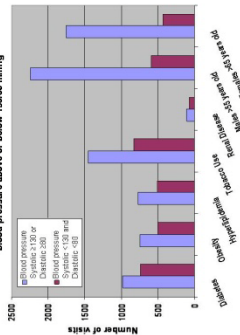


Figure 1: Patients with BP $\geq 130/80$ mmHg had more office visits in each group. The trend is most evident for males >55 years, females >65 years, and tobacco use risk factors.

Figure 2: Cardiovascular disease risk factors in physician office visits with no diagnosis of hypertension by percent of each group, classified by blood pressure above or below 130/80 mmHg.

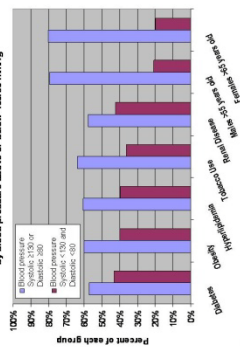


Figure 2: 30% of female patients <65 years had BP $\geq 130/80$ mmHg. Greater than 50% of visits for patients with obesity, hyperlipidemia, tobacco use, male >55 years, and female >65 years had BP $\geq 130/80$ mmHg compared to diabetes or renal disease.

Table 2: Cardiovascular disease risk factors in physician office visits with no diagnosis of hypertension by percentage of total study population ($n=22,744$), NAMCS 2006*

Number of risk factors	Blood pressure above or below 140/90 mmHg	Percent of total	Blood pressure above or below 130/80 mmHg	Percent of total
1 risk factor	6176	30.8%	6185	31.6%
2 risk factors	1020	4.8%	514	2.3%
3 risk factors	304	0.9%	122	0.5%
4 risk factors	23	0.1%	23	0.1%
5 risk factors	0	0.0%	0	0.0%

*CV risk factors include diabetes, obesity, hyperlipidemia, tobacco use, renal disease, male >55 years, and female >65 years. Table 2: Patients with at least one cardiovascular disease risk factor and BP $\geq 130/80$ mmHg comprised 22.8% of the total non-hypertensive study population. 32.4% of the total non-hypertensive study population had at least one cardiovascular disease risk factor.

Conclusions

• 56.8% of those with no diagnosis of hypertension had elevated blood pressure according to current criteria (Table 1).
• BP control rate in our non-hypertensive population was 45.2% (Table 1), surprisingly similar to hypertensive populations (not consistent without blood pressure and assessment and the use of treatment in our study).
• These were our patient office visits with BP $\geq 130/80$ mmHg, which is the threshold for cardiovascular disease risk factors when compared to BP $< 130/80$ mmHg (Figure 1).
• At least one cardiovascular disease risk factor and BP $\geq 130/80$ mmHg was present in 22.8% of the non-hypertensive population (Table 2).

• A greater percentage of patients with obesity, hyperlipidemia, tobacco use, male >55 years, or female >65 years had BP $\geq 130/80$ mmHg when compared to patients with diabetes or renal disease (Figure 2). It may be of benefit to extend the threshold for pharmacologic treatment of hypertension to $\geq 130/80$ mmHg for patients with these additional cardiovascular disease risk factors.

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