

ORIGINAL ARTICLE

Potential Impact of the New American High Blood Pressure Guidelines on Hypertension Prevalence in a Primary Health Care Unit in Rio de Janeiro – the LapARC Study

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Abstract

Background: The new American Heart Association guidelines for hypertension (HT) proposed a reduction of the diagnostic cut-off point, leading to a substantial increase in the prevalence of HT.

Objectives: To assess the prevalence of HT determined by the traditional criteria, the AHA criteria, and home blood pressure monitoring (HBPM) in a population of young adults attending a primary healthcare unit, and its association with cardiovascular risk.

Methods: A cross-sectional population study on adults aged from 20 to 50 years attending a primary healthcare unit, in Rio de Janeiro, Brazil. Sociodemographic and anthropometric data, cardiovascular risk factors, office blood pressure and HBPM were registered. The diagnosis of HT was defined by traditional criteria (office BP $\geq 140 \times 90$ mmHg) and by the new (AHA) criteria (office BP $\geq 130 \times 80$ mmHg). Bivariate analysis was used for comparisons between the two diagnostic criteria, and Kappa coefficient was used to assess the agreement in diagnosis between office BP and HBPM. The level of significance adopted was 5% ($p < 0.05$).

Results: A total of 472 individuals were evaluated (male: 39%; mean age: 38.5 ± 8.7 years). The prevalence of HT was 23.5% and raised to 41.1% with the new AHA criteria. The prevalence of HT using HBPM was 25.5%, but the diagnostic agreement was low ($\kappa = 0.028$) with changes in diagnosis in 18% of the cases.

Conclusion: The prevalence of HT almost doubled with the new AHA diagnostic criteria for HT. HBPM seemed to be an important instrument in HT diagnosis in this population. (Int J Cardiovasc Sci. 2021; 34(3):284-293)

Keywords: Cardiovascular Diseases; Hypertension/diagnosis; Blood Pressure; Epidemiology; Primary Health Care.

Introduction

Hypertension (HT) is usually diagnosed as office blood pressure (BP) equal to or higher than 140×90 mmHg.^{1,2} However, the new American Heart Association (AHA) guidelines recommended to reduce the diagnostic cut-off point for hypertension to $\geq 130 \times 80$ mmHg, leading to an increase in hypertension prevalence.³ Based on this, it is estimated that half of the general population would be considered hypertensive, with greater inclusion of young individuals. It is not clear, however, whether this will bring benefits in terms of leading to lifestyle changes and preventing cardiovascular (CV) events, or if it will simply increase the consumption of anti-hypertensive

drugs. The new guidelines also reinforce the importance of blood pressure measurements outside the office, using Ambulatory Blood Pressure Monitoring (ABPM) or Home Blood Pressure Monitoring (HBPM).¹⁻³

The LapARC study is a population cohort study that aims to evaluate and compare the prevalence of HT using the traditional criteria, the new AHA guidelines, and HBPM, as well as its association with CV risk in this population.

Methods

This is a cross-sectional population study of a cohort of 472 adults (20-50 years of age), selected from a total of 1,100

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patients (43%) enrolled in CSE-Lapa, a school-based primary health center in Rio de Janeiro, Brazil.

Data Collection

In the first evaluation, sociodemographic characteristics (gender and age), physical inactivity (regular physical activity < 150 minutes/week), smoking (current smoking of at least one cigarette a day), previous diagnosis of hypertension, diabetes and dyslipidemia (total cholesterol > 190 mg/dL, LDL-cholesterol > 115 mg/dL, HDL-cholesterol < 40 mg/dL in men and < 46 mg/dL in women, triglycerides > 150 mg/dL or use of statin) were registered.^{1,2} To assess obesity, the following anthropometric measurements were taken: weight and height for calculating Body Mass Index (BMI), abdominal circumference (midpoint between the lower costal margin and the iliac crest) and neck circumference (at the level of the cricothyroid cartilage).^{1,2} The cut-off point used to assess obesity was BMI ≥ 30 kg/m². For abdominal obesity, we considered an abdominal circumference ≥ 88 cm in women and ≥ 102 cm in men, and for increased neck circumference, we used > 41 cm in women and > 43 cm in men.^{1,2}

Blood Pressure Measurements

Office BP was measured using a digital oscillometric device (MicrolifeWatch BP03)⁴ with a cuff suitable for the arm circumference, following the Brazilian Society of Cardiology guidelines.² The average readings obtained from two measurements was considered for analysis. The ankle-brachial index (ABI) was also calculated, as the ratio between the highest systolic BP taken from the lower limb to the highest systolic BP taken from the upper limb; an ABI ≥ 0.9 was considered normal.^{1,2} The diagnosis of HT was defined by traditional criteria – office BP $\geq 140 \times 90$ mmHg^{1,2} – and the new AHA criteria – office BP $\geq 130 \times 80$ mmHg, considering stage I, a systolic BP between 130 and 139 mmHg and diastolic BP between 80 and 89 mmHg, and stage II $\geq 140 \times 90$ mmHg.³

Individuals were considered hypertensive when they previously knew their diagnosis (taking anti-hypertensive drugs or not) and had increased average office BP in two visits.

A subgroup of 218 individuals who were not using anti-hypertensive drugs underwent HBPM (HEM-705 CP, Omron Healthcare, Kyoto, Japan)⁵, which is considered the gold standard for the diagnosis of

HT. A 7-day protocol, with four daily measurements (two in the morning and two in the afternoon), was used.⁶ The measurements taken on the first day were discarded and the average of the remaining six days was used in the analysis. Normal BP was defined as < 135 x 85 mmHg, following the Brazilian Guidelines on hypertension (traditional criteria).^{2,6} Based on office BP and HBPM, individuals were classified in four phenotypes: (i) normotension with controlled office BP and HBPM, (ii) sustained HT with uncontrolled office BP and uncontrolled HBPM, (iii) white coat HT (WCHT) with increased office BP and controlled HBPM, and (iv) masked hypertension (MHT) with normal office BP and uncontrolled HBPM.

Electrocardiography (ECG)

Individuals underwent resting ECG to calculate voltage indexes for the diagnosis of left ventricular hypertrophy (LVH). The Sokolow index was calculated by the formula SV1 + RV5 (cohort value ≥ 35 mm) and the Cornell index by RaVL + SV3 (≥ 20 mm to women and ≥ 28 mm to men).^{1,2}

Statistical Analysis

The statistical analysis was made using the SPSS 19.0 (SPSS, Chicago, IL). Since it was a population study, a convenience sample was used. Data normality was verified using a histogram and a quantile-quantile (Q-Q) plot. Continuous variables showed normal distribution and were described as mean and standard deviation (SD). Bivariate analysis was used in the analysis of HT diagnosis by traditional criteria and by the new AHA guidelines, and comparisons were performed by unpaired Student's t test (continuous variables with normal distribution) and the χ^2 test (categorical variables). The prevalence of the four hypertension phenotypes (normotension, sustained HT, WCHT and MHT) was calculated, and the agreement in HT diagnosis between the two methods was assessed by Kappa coefficient. One-Way ANOVA was used to evaluate differences in continuous variables between different groups, with p value calculated in relation to the normotensive group. The significance level adopted was 5% (p<0.05).

The variables sex, age > 39 years (mean age of the population), obesity, increased neck circumference, smoking, physical inactivity and the Sokolow-Lyon and Cornell indexes were examined in a multiple logistic regression model, and the HT diagnostic criteria (traditional

criteria, new AHA criteria and HBPM) were used as dependent variables. A step-by-step procedure was used to select the independent covariables (variables with $p < 0.10$ were selected to be added and remain in the models). The Hosmer-Lemeshow goodness-of-fit test and the area under the ROC curve were used to assess calibration and discrimination of the models. The results were presented as odds ratio (OR) and 95% confidence interval (CI).

Ethical considerations: The study was approved by the Research Ethics Committee of the institution and all participants signed an informed consent form.

Results

A total of 472 individuals were assessed; 186 (39%) were male, and mean age was 38.5 ± 8.7 years. Seventy-one (15%) patients reported previous diagnosis of hypertension, of which 62 (87%) were under pharmacological treatment, and 37 (52%) had good blood pressure control.

According to the traditional criteria, 109 (23%) individuals were considered hypertensive (stage II), and 192 individuals (41%) were hypertensive using the new criteria (stage I). These 83 “new” hypertensive patients according to the AHA criteria, were mostly men, less

sedentary, with increased neck circumference (Table 1). When compared with stage II hypertensive patients ($n=109$), stage I hypertensive subgroup was younger (38.3 ± 9.2 vs 43.0 ± 8.1 years; $p < 0.001$), had a lower prevalence of abdominal obesity (27% vs 59%; $p < 0.001$) and physical inactivity (27% vs 59%; $p = 0.04$), and lower BMI, neck circumference and Sokolow and Cornell indexes. They also had a lower (but not statistically significant) ABI compared with normotensive individuals (Table 2).

The prevalence of hypertension diagnosed by HBPM was 25.7% ($n=56$). Despite the similarity between the prevalence rates for office BP (23.1%) and for HBPM (25.7%), the diagnostic agreement was very low (Kappa coefficient = 0.028). In HBPM, we identified 167 normotensive individuals, 13 with sustained hypertension, 18 with WCHT and 20 with MHT. Therefore, in 17.5% of the cases ($n=38$), the diagnosis of HT changed with HBPM (Figure 1).

Individuals with WCHT were mostly men, had greater neck circumference and an increased Cornell index as compared with normotensive subjects. These patients showed not only increased office BP, but also increased home BP compared with normotensive individuals. Compared with sustained HT patients, individuals with WCHT had a lower BMI (28.1 ± 3.9 vs 30.9 ± 3.2 kg/m²,

Table 1 - Baseline characteristics of the total population and of normotensive and hypertensive groups according to the American Heart Association (AHA) and the traditional diagnostic criteria for hypertension

Characteristics	Total population (n=472)	Normotension (n=280)	Hypertension by AHA ^a (n=83)	Hypertension by traditional criteria ^b (n=109)
Male, n(%)	186 (39.4)	81 (28.9)	45 (54.2) ‡	60 (55.0) ‡
Obesity, n(%) ¹	115 (24.4)	51 (18.2)	19 (22.9)	45 (41.3) ‡
Abdominal obesity, n(%) ²	177 (37.5)	91 (32.5)	22 (26.5)	64 (58.7) ‡
Increased neck circumference, n(%) ³	53 (11.2)	12 (4.3)	9 (10.8) *	32 (29.4) ‡
Diabetes, n(%)	16 (3.4)	4 (1.4)	3 (3.6)	9 (8.3) †
Physical inactivity, n(%)	206 (43.6)	127 (45.4)	27 (32.5) *	52 (47.7)
Smoking, n(%)	68 (14.4)	39 (13.9)	16 (19.3)	13 (11.9)
Dyslipidemia, n(%)	85 (18.0)	47 (16.8)	12 (14.5)	26 (23.9)

^a AHA criteria (BP $\geq 130 \times 80$ mmHg); ^b traditional criteria (BP $\geq 140 \times 90$ mmHg)

¹ Obesity: BMI > 30 kg/m²

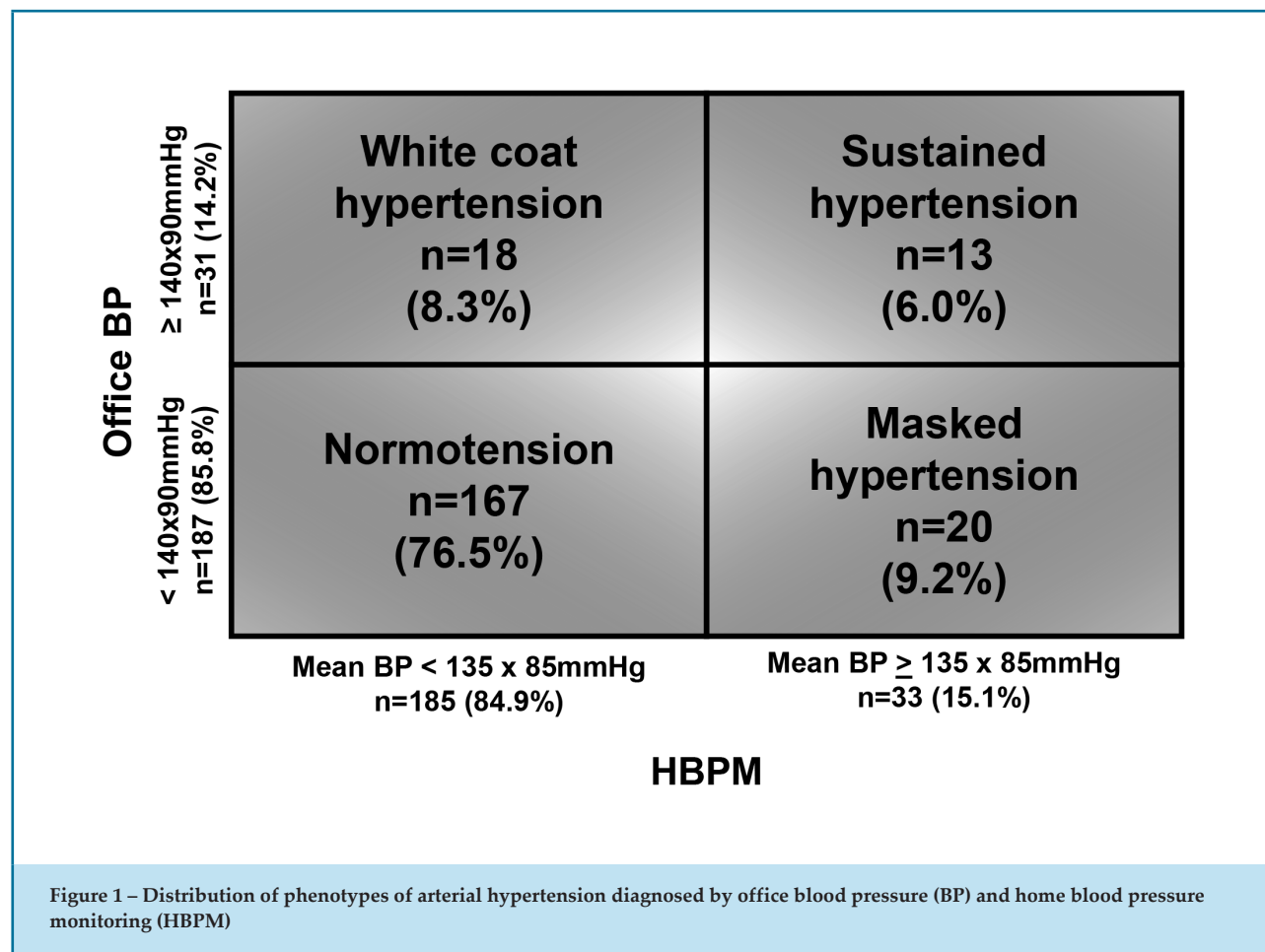
² Abdominal obesity – increased abdominal circumference: >88 cm in women and >102 cm in men

³ Increased neck circumference: >41 cm in women and >43 cm in men

Values are averages (SD) or absolute numbers and percentages,

χ^2 test - p value calculated in relation to reference group (normotension)

* $p < 0.05$; † $p < 0.01$; ‡ $p < 0.001$



$p = 0.03$). Except for office BP and home BP values, patients with MHT were similar in terms of CV risk factors compared with patients with sustained HT (Table 3).

In multiple logistic regression, obesity was independently associated with the diagnosis of HT, regardless of the diagnostic criteria, increasing the risk of developing HT by 2 to 3 times, and the only factor associated with the diagnosis of HT by HBPM. Increased neck circumference, male gender and older age were associated with the risk of HT by office BP (Table 4).

Discussion

The main finding of our study was the increase in the prevalence of HT from 23% by the traditional criteria (office BP criteria) to 41% by the new AHA criteria in a population of young adults. These patients, diagnosed with HT only by the AHA but not by the traditional criteria, have characteristics suggestive of higher CV risk, such as higher neck circumference and higher

voltage index on the ECG. Regarding the diagnosis of HT by HBPM, although the prevalence of HT was comparable to that by office BP, the concordance between the two methods was very low, with 18% of the participants having their diagnosis modified with home BP measurements.

Individuals classified as stage 1 by the new AHA guidelines did appear to have a higher CV risk compared to normotensive individuals, suggesting that the early diagnosis of this condition, in the context of primary care, in a younger population, may be important to reduce future risks. Studies in different countries have shown that diagnosis, treatment and control of HT are lower among young adults.^{7,8} On the other hand, when properly assisted and treated, these individuals are more likely to achieve blood pressure control when compared to the elderly. Changes in lifestyle are more feasible and effective in individuals with little endothelial injury and less arterial stiffness, denoting the relevance of the primary prevention strategy.⁹

Table 2 – Baseline characteristics of the individuals by blood pressure stages defined by the American Heart Association

Blood pressure stage	Variables average (SD)	95%CI	p value*
Age, years			
Normal (n=280)	36.6 (8.4)	35.6-37.6	Reference
Stage I (n=83)	38.3 (9.2)	36.2-40.3	0.37
Stage II (n=109)	43.0 (8.1)	41.4-44.5	< 0.001
Body mass index, kg/m²			
Normal (n=280)	26.1 (4.9)	25.5-26.7	Reference
Stage I (n=83)	27.2 (5.2)	26.1-28.4	0.28
Stage II (n=109)	29.7 (6.0)	28.6-30.9	< 0.001
Abdominal circumference, cm			
Normal (n=280)	84.4 (17.4)	82.3-86.4	Reference
Stage I (n=83)	88.3 (15.0)	85.0-91.6	0.17
Stage II (n=109)	99.6 (14.4)	96.8-102.3	< 0.001
Neck circumference, cm			
Normal (n=280)	34.8 (6.2)	34.1-35.6	Reference
Stage I (n=83)	37.8 (3.8)	37.0-38.6	< 0.001
Stage II (n=109)	39.9 (4.4)	39.0-40.7	< 0.001
Sokolow-Lyon Index, mm			
Normal (n=280)	17.2 (5.2)	15.9-18.5	Reference
Stage I (n=83)	20.0 (5.7)	17.7-22.3	0.09
Stage II (n=109)	20.9 (5.6)	19.1-22.6	0.004
Cornell Index, mm			
Normal (n=280)	10.4 (4.1)	9.3-11.4	Reference
Stage I (n=83)	12.7 (4.8)	10.8-14.7	0.05
Stage II (n=109)	13.0 (3.9)	11.7-14.2	0.009
Systolic blood pressure, mmHg			
Normal (n=280)	110 (18)	108-113	Reference
Stage I (n=83)	127 (8)	125-129	< 0.001
Stage II (n=109)	138 (16)	135-141	< 0.001
Diastolic blood pressure, mmHg			
Normal (n=280)	68 (12)	67-69	Reference
Stage I (n=83)	81 (5)	79-82	< 0.001
Stage II (n=109)	85 (10)	83-87	< 0.001
Pulse pressure, mmHg			
Normal (n=280)	42 (10)	41-43	Reference
Stage I (n=83)	47 (11)	44-49	0.004
Stage II (n=109)	53 (13)	51-55	< 0.001
Ankle-Brachial Index			
Normal (n=280)	1.15 (0.20)	1.12-1.17	Reference
Stage I (n=83)	1.14 (0.23)	1.10-1.19	1.00
Stage II (n=109)	1.11 (0.24)	1.06-1.16	0.43

*One-way ANOVA to assess the difference between groups

Table 3 – Baseline characteristics of four blood pressure phenotypes, defined by office blood pressure and by home blood pressure monitoring (HBPM)

	Total population (n=218)	Normotension (n=167)	White coat hypertension (n=18)	Masked hypertension (n=20)	Sustained hypertension (n=13)
Cardiovascular Risk Factors					
Male, n(%) ^a	79 (36.2)	50 (29.9)	14 (77.8) [‡]	8 (40.0)	7 (53.8)
Age, years ^b	39.5 (8.2)	39.1 (8.2)	39.8 (8.4)	40.3 (8.3)	43.2 (6.6)
Body mass index, kg/m ²	27.6 (5.4)	26.9 (5.2)	28.1 (3.9)	30.8 (7.3) [‡]	30.9 (3.2)
Obesity, n(%) ^a	45 (25.7)	34 (20.4)	5 (27.8)	10 (50.0) [‡]	7 (53.0) [‡]
Abdominal obesity ¹ , n(%) ^a	79 (36.2)	54 (32.3)	7 (38.9)	9 (45.0) [*]	9 (69.2) [‡]
Increased neck circumference ² , n(%) ^a	18 (8.3)	7 (4.2)	4 (22.2) [‡]	4 (20.0) [‡]	3 (23.1) [‡]
Diabetes, n(%) ^a	9 (4.1)	5 (3.0)	1 (5.6)	1 (5.0)	2 (15.4)
Physical inactivity, n(%) ^a	101 (46.3)	79 (47.3)	4 (22.2)	11 (55.0)	7 (53.8)
Smoking, n(%) ^a	26 (11.9)	19 (11.4)	1 (5.6)	3 (15.0)	3 (23.1)
Dyslipidemia, n(%) ^a	46 (21.1)	36 (21.6)	5 (27.8)	3 (15.0)	2 (15.4)
Office BP, mmHg					
Systolic BP ^b	122 (14)	117 (10)	144 (5) [‡]	123 (13) [‡]	149 (10) [‡]
Diastolic BP ^b	74 (9)	71 (7)	86 (7) [‡]	78 (9) [‡]	90 (9) [‡]
Pulse pressure ^b	47 (10)	45 (9)	58 (10) [‡]	45 (10)	49 (10) [‡]
HBPM, mmHg					
Systolic BP ^b	120 (12)	115 (9)	125 (8) [‡]	135 (9) [‡]	145 (9) [‡]
Diastolic BP ^b	74 (9)	71 (6)	75 (6) [*]	87 (7) [‡]	88 (9) [‡]
Pulse pressure ^b	46 (8)	45 (6)	49 (7) [*]	48 (9)	57 (12) [‡]
Electrocardiogram					
Sokolow-Lyon Index (mV) ^b	18.9 (5.6)	18.2 (5.4)	21.6 (4.5)	21.0 (7.2)	19.9 (6.1)
Cornell Index (mV) ^b	11.5 (4.4)	11.2 (4.2)	15.6 (3.6) [‡]	9.3 (2.8)	12.3 (5.3)

¹ Abdominal obesity: increased abdominal circumference: >88 cm in women and >102 cm in men

² Increased neck circumference: >41 cm in women and >43 cm in men

BP: blood pressure

^a χ^2 test (categorical variables)

^b Unpaired Student's t test (continuous variables)

* $p < 0.05$; † $p < 0.01$; ‡ $p < 0.001$, p value calculated in relation to reference group (normotension)

When shedding light on the new AHA guidelines, it is noted that stage I hypertensive patients were previously labeled "prehypertensive" by the seventh report of the Joint National Committee on prevention, detection, evaluation, and treatment of high blood pressure (JNC7).¹⁰ This designation aimed to identify individuals at greater risk of developing HT and to intervene early

with the adoption of a healthy lifestyle. The term was intended to reduce therapeutic inertia, but paradoxically, less care was delivered.¹⁰

By reclassifying individuals, the AHA created a disease condition that affects people who were previously considered healthy. It is essential to note that the new definition may result in early diagnosis and prevention,

Table 4 - Multiple logistic regression for cofactors independently associated with hypertension by the traditional criteria, American Heart Association criteria, and home blood pressure monitoring (HBPM)

HT by traditional criteria (n=109)			
Cofactors	OR	95%CI	p-value
Male	2.48	1.46-4.22	0.001
Increased neck circumference	3.40	1.31-8.81	0.012
Obesity	2.45	1.39-4.30	0.002
Age > 39 years	3.77	2.18-6.49	< 0.001
HT by AHA criteria (n=83)			
Cofactors	OR	95%CI	p-value
Male	3.05	1.94-4.81	< 0.001
Increased neck circumference	3.91	1.24-12.4	0.02
Obesity	2.08	1.24-3.49	0.005
Age > 39 years	2.23	1.44-3.45	< 0.001
Sustained HT by HBPM (n=13)			
Cofactors	OR	95%CI	p-value
Male	1.38	0.57-3.33	0.48
Increased neck circumference	1.65	0.45-6.00	0.45
Obesity	3.07	1.28-7.36	0.012
Age > 39 years	1.46	0.62-3.48	0.39

Hosmer-Lemeshow goodness-of-fit test: p=0.604, area under the ROC curve 0.791 (95% IC 0.745-0.838). Multiple logistic regression. The model was adjusted for sex, age > 39 years, obesity, increased neck circumference, smoking, physical inactivity, Sokolow-Lyon e Cornell indices. HT: hypertension; AHA: American Heart Association; HBPM: Home Blood Pressure Monitoring; OR: Odds Ratio; CI: confidence interval.

more accurate screening for subclinical lesions and reduction in CV outcomes. Our study showed that these individuals have higher BMI, greater neck circumference and early changes in voltage indexes on the ECG when compared to normotensive individuals, pointing to a higher CV risk and greater chances of developing target organ damage, corroborating a possible positive effect in reducing BP cutoff point for hypertension.³ However, these individuals now considered hypertensive (by the AHA criteria) would probably initiate pharmacological therapy earlier, and possibly experience more side effects, leading to higher costs to public health services,¹¹ in addition to a progressive reduction in treatment adherence. Vrijens et al.,¹² in a longitudinal study with electronic monitoring of medication, showed that after one year, half of the patients abandoned the pharmacological therapy.

Therefore, it is important to balance risks and benefits for this population. If, on the one hand, pharmacological therapy reduces CV risk and possible target organ lesions,¹⁰ on the other, it may increase the likelihood of low output syndrome, and make hypertension management difficult.^{3,11}

Home Blood Pressure Monitoring

The increasing importance of HBPM in primary care as a diagnostic and monitoring method for therapeutic response has been studied.¹³⁻¹⁵ Currently, several guidelines^{1,2} suggest that, whenever possible, ABPM or HBPM should be indicated at the time of diagnosis, and the AHA³ recommends that HT diagnosis be based on elevated office BP followed by confirmatory ABPM or

HBPM. Compared with ABPM, HBPM is generally more accepted by patients and has a lower cost,^{6,16} in addition to refining the diagnosis and having a higher predictive value of future CV events than office BP;¹⁷ it is therefore considered a good option for underdeveloped countries.¹³ We emphasize that the use of HBPM in primary care is recommended by the Brazilian Ministry of Health,¹⁸ although in clinical practice it has not been used due to economic and logistical issues.

In our country, the diagnosis of HT is based on office BP because it is a simple and low-cost procedure,² despite the limitations of this method, especially in individuals with WCHT and MHT.^{13,19} In the present study, despite the similar prevalence of HT diagnosed by office BP and HBPM, the diagnostic agreement was very low and, in almost 20% of the population, the diagnosis of HT has changed, which corroborates the importance of measuring BP out of the office, including in primary care.^{13,14,18,20}

Analyzing individuals with WCHT in our study, we observed that despite normal home BP levels, they seem to present a higher CV risk associated with greater neck circumference, wider pulse pressure, and early elevation of the Cornell index, although still within normal ranges. Several studies have demonstrated a higher CV risk and higher risk for HT associated with WCHT.²¹⁻²³ This is in line with our results, which showed that individuals with WCHT have higher (but controlled) home BP levels compared with normotensive individuals (Table 3). They also showed higher Cornell voltage on ECG suggesting LVH, increased neck circumference suggesting a higher risk for obstructive sleep apnea and an increased office pulse pressure and HBPM that may reflect greater arterial stiffness, despite the younger age (Table 3). There is evidence to suggest the need to follow-up this group of patients, regarding lifestyle changes and the possibility of developing sustained hypertension.^{1-3,9}

Analysis of MHT patients in our study revealed that, except for office BP, these patients behaved in a similar way to the sustained ones. A meta-analysis of 12 studies with 4,884 untreated individuals, 2,467 of whom were normotensive, 776 patients with MHT and 1,641 patients with sustained hypertension, showed an association between MHT and increased risk of LVH.²⁴ In another meta-analysis, the prognosis of individuals with WCHT was similar to that of normotensive individuals, while patients with MHT had a higher prevalence of subclinical lesions such as LVH, carotid wall thickening and microalbuminuria.²⁴ In the Finn-Home Study, a

progressive increase in the incidence of CV events and total mortality in normotension, WCHT, MHT and sustained hypertension was observed,²⁵ while a recent study showed that individuals with MHT have twice the risk of developing LVH.²⁶ Possibly, the difficulty in detecting MHT and consequent lack of treatment contribute to this poor prognosis profile.

In our population, obesity was the common independent risk factor for the diagnosis of HT between the three diagnostic criteria (Table 4). A recent randomized clinical trial developed in several centers in Brazil showed that changes in eating habits had little impact on the secondary prevention of CV events,²⁷ but there are no studies demonstrating their long-term effects on reducing obesity and consequently CV risk.

It is also noteworthy that greater neck circumference increased the odds of having HT by almost four times, regardless of the diagnostic criteria system. Perhaps screening for sleep apnea in a younger population and initiating treatment and instituting treatment at earlier ages may reduce CV morbidity and mortality in the future; this has not yet been proven in patients with more severe HT and elderly patients using continuous positive airway pressure.²⁸

Our study has two main limitations. Our sample was composed of young, economically active individuals, who self-reported as 'healthy'; these individuals do not usually seek health services. Although this group of individuals lived in an area covered by the CSE-Lapa, many were not even registered in the unit, which made it difficult to enroll these subjects in the study. Thus, most of our study population attended the CSE-Lapa, which generated a selection bias. This fact can be confirmed by the mean age of the cohort, which was higher than expected. Another limitation was the predominance of women (61.5%), apparently related to the well-recognized greater demand for healthcare services by women (including preventive tests, prenatal care etc.), while we know that in this age group (<50 years, men have higher CV risk than women. As it is a study with individuals aged between 20 and 50 years, the conclusions cannot be extrapolated to other age groups.

Conclusion

As expected, adopting the new AHA criteria caused a significant increase in the prevalence of HT in a population of young adults. However, it is not clear if these individuals would have a higher CV risk,

pointing to the need for future longitudinal studies. In addition, BP measurements outside the office would be important for a more accurate diagnosis of HT in primary care.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

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Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee of the *Universidade Estácio de Sá* under the protocol number 50605215.4.0000.5284. All the procedures in this study were in accordance with the 1975 Helsinki Declaration, updated in 2013. Informed consent was obtained from all participants included in the study.

Author Contributions

Conception and design of the research: Oliveira MG, Almeida da Silva AF, dos Santos TL, Muxfeldt ES. Acquisition of data: Oliveira MG, Almeida da Silva AF, dos Santos TL, Cunha ML, Taveira BRF, Muxfeldt ES. Analysis and interpretation of the data: Oliveira MG, Almeida da Silva AF, dos Santos TL, Muxfeldt ES. Statistical analysis: Muxfeldt ES. Obtaining financing :Muxfeldt ES. Writing of the manuscript: Oliveira MG, Almeida da Silva AF, dos Santos TL, Cunha ML, Taveira BRF, Muxfeldt ES. Critical revision of the manuscript for intellectual content: Oliveira MG, Muxfeldt ES.

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