Evaluation of the awareness, control and cost-effectiveness of hypertension treatment in a Brazilian city: populational study

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Objectives **Hypertension is a highly prevalent disease worldwide, constituting one of the main risk factors for cardiovascular morbidity and mortality. The aims of this study were to evaluate the level of awareness and control of hypertension comparing sex, socioeconomic and educational level, BMI and drug therapy in over 40-year-old patients. The cost-effectiveness of the main pharmacologic classes of antihypertensives, as monotherapy and combination therapy, was also assessed.**

Methods **In this randomized and cross-sectional populational study, a sample of 738 hypertensive adults with ages at least 40 years were evaluated. Of these, 345 (46.7%) were men and 393 (53.3%) were women.**

Results **A total of 72.9% of the hypertensives knew about their disease. Women in the 40–49 and 50–59 age groups and obese individuals had a higher rate of awareness of their hypertensive status. The rates of awareness were similar in different social classes and educational levels, however, blood pressure control varied. β-Blockers were the most effective drugs to control blood pressure with no differences being observed between monotherapy and combinations. Diuretics were the most cost-effective.**

Conclusion **Approximately half of the participants received monotherapy. The best percentage of control with monotherapy was obtained with β-blockers but the diuretics treatment was the most cost-effective. The levels of awareness and control were high compared with developed countries, most evident in the higher social classes and higher education levels.** ***J Hypertens*** **27:1900–1907 © 2009 Wolters Kluwer Health | Lippincott Williams & Wilkins.**

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Keywords: awareness, control, cost-effectiveness, hypertension, treatment

Abbreviations: ACEI, angiotensin-converting enzyme inhibitors; BP, blood pressure; IBGE, Brazilian Institute of Geography and Statistics; NHANES, National Health and Nutrition Examination Survey

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Introduction

Hypertension is a highly prevalent disease worldwide, constituting one of the main risk factors for cardiovascular morbidity and mortality as well as causing a negative impact on the quality of life [1–3]. In 2000, the estimated prevalence of hypertension in the adult population worldwide was 26.4% with 972 millions of hypertensive individuals [4,5]. In 2025, according to Kearney *et al.* [5], 29% of the adult world population will be hypertensive, which is approximately 1.56 billion people.

Despite the recent progress in prevention, detection and treatment, hypertension is still considered an important public health problem. The reduction in the rates of cardiovascular morbidity and mortality depends mainly on effective control of blood pressure (BP), which may, potentially, be obtained from changes in lifestyle, adequate therapeutic management and compliance to treatment. The degree of awareness and/or control of hypertension depend on several factors including socioeconomic and education level, access to medical services, environmental conditions, diet, physical activity and stress [6]. A study assessing hypertension treatment and control carried out in the 1990s observed that the percentages of hypertensive individuals treated and the rates of control vary among European and North American countries. England presented with the lowest rate of treatment (25%), followed by Sweden (26%), Germany (26%), Spain (27%) and Italy (32%). The highest treatment rates were in the United States (53%) and Canada (36%) [3,5]. In the period 2003–2004, an increase in these rates was observed according to the National Health and Nutrition Examination Survey (NHANES), with a rate of awareness of 75.7%, 65.1% under treatment and 36.8% controlled [7]. The goal for control of hypertension in the United States in 2010 (BP $<$ 140/90 mmHg) is that 50% of hypertensive individuals should have their BP controlled. To reach this objective, 80% of hypertensive individuals should be aware of their status, 90% of these should be under treatment and 70% controlled [4].

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The prevalence of hypertension in Brazil varies from 14 to 47.9% according to different sample selection criteria utilized by different studies [1].

Currently the efficacy of hypertension treatment using monotherapy compared with drug combinations is being discussed. The seventh report of the Joint National Committee recommends thiazide-type diuretics as first-line treatment of hypertensive patients without co-morbidities. On the contrary, the Brazilian and European guidelines do not recommend any specific class of drug at the beginning of hypertension treatment, thus leaving the decision to the criteria of the physician [8,9].

The objectives of this study were to evaluate, in a representative populational sample of over 40-year olds, the level of awareness, control of hypertension and the relationship with demographic, socioeconomic and educational factors. Additionally, the effect on control using monotherapy or combined treatment and the cost-effectiveness of the most commonly utilized antihypertensive medicines were assessed.

Methods

Study participants

The current project was approved by the Research Ethics Committee of the Medicine School in São José do Rio Preto. All the participants were informed about the purpose of the work and provided informed consent before participating in the study.

A cross-sectional study was performed in the period of 2004 and 2005 of a sample representative of the adult ($\geq$40 years old) urban population of São José do Rio Preto, São Paulo State, Brazil. The over 40-year-old population of the city was approximately 112 000 inhabitants (total population approximately 400 000), with a predominance of whites and a relatively balanced distribution between men and women. The sample was stratified by age groups of 40–49, 50–59, 60–69 and at least 70 years old.

For the calculation of the sample size, the number of inhabitants according to the census of the Brazilian Institute of Geography and Statistics (IBGE) was taken into account together with the expected prevalence of hypertension in each age group using a confidence interval (Cl) of 95% and a maximum error of 3% [10]. The city was divided in census sectors and the number of individuals studied from each sector was proportional to the population of that area. In each sector, the district, street, house and an adult (resident for more than 6 months) was chosen at random observing the inclusion and exclusion criteria of the study. After the first house visited, houses on alternating sides of the street, skipping two residences, were visited. In cases of refusal to participate in the study, an adult resident in the neighboring house was randomly chosen.

Exclusion criteria were pregnancy, severe degenerative diseases, incapacitating mental diseases, severe psychiatric diseases, mental deficiency and bedridden patients.

Participants answered a questionnaire with personal data, socioeconomic levels, number of years of schooling, lifestyle, personal and family medical history, awareness about their hypertensive status and details of drugs taken. Subsequently physicians evaluated the interviews and measured the pulse, BP and anthropometric data (weight, stature).

The BP was measured by the technique standardized by the Joint National Committee [11]. An aneroid sphygmomanometer was utilized, calibrated using a mercury tensiometer, and a cuff appropriate for the size of the participant's arm. BP measurements were taken in the seated position after 5–10 min of resting without smoking and drinking coffee or alcoholic beverages. The criteria adopted for diagnosis of hypertension was a systolic BP at least 140 mmHg and/or diastolic BP at least 90 mmHg or the use of antihypertensive agents.

The individuals were classified as normotensive persons, unknown hypertensive, treated controlled hypertensive and treated uncontrolled hypertensive patients. Hypertensive individuals who knew their hypertensive status but did not treat were considered unknown hypertensive patients.

The socioeconomic level was classified initially as A, B, C, D and E according to the family's possessions and income, with category A being the highest level. Later, for statistical analysis, A and B were grouped together as were D and E. The level of education was defined by the number of years at school, dividing the sample in three groups: E1 from 0 to 8 years, E2 from 8 to less than 11 years and E3 at least 11 years or a completed higher education course [12].

The BMI was calculated as weight in kilograms divided by the square of height in meters (kg/m^2). The height was measured using a metric tape. A portable calibrated weighing scale was utilized to measure the weight. The participants were classified according to their BMI as normal weight (BMI $<$25), overweight (BMI 25–29.9) and obese (BMI $\geq$30 kg/m^2).

The prevalence of awareness and control of hypertension were compared in the population by age groups, sex, years of schooling, socioeconomic class and BMI.

The percentage of BP control with monotherapy and combinations of drugs was attained comparing the most utilized drugs.

The costs of antihypertensives were calculated questioning which medications were being used, the doses and

the number of times taken per day. From these data the daily and monthly costs were calculated for different pharmacological therapies according to similar published models [13,14].

Prices of medications were obtained using the Internet sites that contain the prices of medications in April 2006 [15,16]. As the number of tablets and capsules vary among different products and manufacturers, the price was calculated per unit of each pharmacological agent, thereby establishing the true monthly cost of treatment.

The cost-effectiveness ratio was calculated multiplying the mean monthly cost of individual treatment by the number of patients treated and dividing by the percentage of controlled patients [13]. On comparing two or more pharmacological agents, the most cost-effective was the one with the lowest cost-effectiveness ratio.

Statistical method

Analysis of the qualitative variables was achieved by the relative frequencies and associations within age groups were assessed using the Pearson's χ^2 or Fisher's exact tests. The comparisons of percentages between age groups was made with the likelihood ratio test for independent variables and the level of population by discrete multivariate analysis, with the population proportions corrected according to the proportions in the age groups [17]. Quantitative variables were analyzed using the mean, standard deviation, median and quartiles, and analysis of comparisons, in relation to the factors of interest within and between age groups employing analysis of variance. The evaluation of the results of medicinal treatment comparing monotherapy with drug combinations was performed by Bootstrap simulation of corrected means with the same weights utilized for the analysis of the frequencies, where 1000 Bootstrap samples were generated for each comparison. The level of significance was set at an α error $= 5\%$ ($P \leq 0.05$) [18,19].

Results

The data in this study originate from a population sample of 1492 individuals at least 40 years old, 760 women, 50.8% (95% CI: 48.1–59.1%) and 732 men, 49.2% (95% CI: 46.5–51.9%) with 754 normotensive and 738 hypertensive. The prevalence of hypertension corrected for this population (≥40 years) was 43.3% (95% CI: 40.9–45.7%) with the following distribution by age: 40–49 years old: 23.8% (95% CI: 19.7–28.3%); 50–59 years old: 45.2% (95% CI: 40.6–50.0%); 60–69 years old: 65.9% (95% CI: 61.8–71.7%) and at least 70 years old: 69.8% (95% CI: 64.0–75.1%). The analysis of the data of awareness of hypertension and BP control are shown in Table 1.

Awareness

A total of 72.9% of the interviewees were aware of their hypertensive status (95% CI: 69.5–76.3%); higher for women, 80.3% (95% CI: 75.8–84.0%) than for men, 64.9% (95% CI: 59.2–69.8%), $P < 0.00001$.

In the 40–49 age group the prevalence of awareness was relatively low, 61.7% (95% CI: 51.1–71.5%, $P = 0.02$). In relation to the BMI, the obese population presented with a higher prevalence of awareness, 80.5%, (95% CI: 71.5–85.3%) compared with overweight 71.6%, (95% CI: 65.4–76.7%, $P = 0.03$) and normal individuals 65.6% (95% CI: 58.3–71.6%, $P = 0.001$). There were no significant differences between overweight and normal-weight participants in all age groups.

The prevalence of awareness was statistically similar among all the socioeconomic classes: AB – 74.9% (95% CI: 66.1–81.3%), C – 70.6% (95% CI: 60.5–78.2%) and DE – 74.3% (95% CI: 68.5–79.0%).

Similar results of awareness were observed among the different levels of education: E1 – 72.7% (95% CI: 68.5–76.3%); E2 – 69.2% (95% CI: 49.4–81.3%) and E3 – 74.9% (95% CI: 65.6–81.7%).

Table 1 Demographic data and prevalence of awareness and control

Variable	Condition	*N*	%	Awareness	*P*	Control	*P*
Sex	Male	345	46.75	64.9 (59.2–69.8)	<0.00001	53.0 (46.9–58.4)	NS
	Female	393	53.25	80.3 (75.8–84.0)		52.7 (45.6–58.9)	
Age group (years)	40–49	94	12.73	61.7	0.02	56.9	
	50–59	203	27.51	75.4		54.3	
	60–69	247	33.34	78.1		49.7	NS
	≥70	194	26.42	74.7		51.7	
Socioeconomic level	AB	144	19.50	74.9 (66.1–81.3)		65.2 (54.5–73.7)	*P* (1–2): 0.04
	C	300	40.60	70.6 (60.5–78.2)	NS	62.5 (45.1–58.9)	*P* (1–3): 0.003
	DE	294	39.90	74.3 (68.5–79.0)		55.9 (38.7–52.3)	*P* (2–3): NS
Schooling (number of years)	E1: 0 to 8	566	76.70	72.7 (68.5–76.3)		47.6 (42.4–52.3)	*P* (E1–E3): 0.002
	E2: 8 <11	42	5.70	69.2 (49.4–81.3)	NS	61.2 (38.9–75.3)	*P* (E1–E2): NS
	E3: ≥11	130	17.60	74.9 (65.6–81.7)		68.1 (56.9–76.4)	*P* (E2–E3): 0.20
BMI (kg/m^2)	Normal	220	29.80	65.6 (58.3–71.6)	*P* (3–1): 0.001	56.0 (46.5–63.9)	
	Overweight	286	38.80	71.6 (65.4–76.7)	*P* (3–2): 0.03	55.9 (48.3–62.3)	NS
	Obese	232	31.40	80.5 (71.5–85.3)	*P* (1–2): NS	48.7 (40.9–55.4)	

NS, not significant.

Blood pressure control

The percentage of BP control considering all the hypertensive individuals was 38.6% (95% CI: 34.9–42.2%) and among treated hypertensive patients it was 52.9% (95% CI: 48.3–57.5%). The estimated prevalence of hypertension control was similar between sexes: women 53.0% (95% CI: 46.9–58.4%) and men 52.7% (95% CI: 45.6–58.9%).

No significant differences were observed in BP control among the different age groups. Likewise, the frequency of controlled individuals was similar in respect to the BMI: normal 56.0% (95% CI: 46.5–63.9%), overweight 55.9% (95% CI: 48.3–62.3%) and obese 48.7% (95% CI: 40.9–55.4%).

The prevalence of BP control was significantly higher in the AB socioeconomic class in respect to the other classes: AB – 65.2% (95% CI: 54.5–73.7%). C – 62.5% (95% CI: 45.1–58.9%, $P=0.04$) and DE – 55.9% (95% CI: 38.7–52.3%, $P=0.03$). The prevalence was greater in Class C compared to DE ($P=0.04$).

A higher prevalence of BP control was seen in the population with more years of schooling, E3 – 68.1% (95% CI: 56.9–76.4%) compared with E1 – 47.6% (95% CI: 42.4–52.3%, $P=0.002$). There were no significant differences between E1 and E2 and between E2 and E3. On stratifying by age groups, there was a higher prevalence of BP control in group E3 in the 40–49 age group ($P=0.038$). All the dates are in Table 2.

The mean BP levels of normal, unknown, treated controlled, treated noncontrolled individuals are in Table 3.

Hypertension control according to the number of pharmacological agents

Of the 549 patients under treatment, 44.6% ($n=245$) received monotherapy, 41.2% ($n=226$) were treated with two medications and 14.2% ($n=78$) received an association of three or more drugs.

Comparison of the efficacy of monotherapy and associations in relation to blood pressure control

The rates of hypertension control corrected by population were estimated for monotherapy – 50.9% (95% CI: 44.6–58.0); two pharmacological agents – 53.9% (95% CI: 47.3–61.4%) and three or more pharmacological agents – 56.1% (95% CI: 45.4–69.2%). There was no statistically significant difference in BP control comparing monotherapy with an association of pharmacological agents (Table 4).

Comparison of the main pharmacological groups used in monotherapy

Among the hypertensive individuals treated by monotherapy, 43.3% ($n=106$) utilized angiotensin-converting enzyme inhibitors (ACEI); 26.1% (64) diuretics, 20.0% (49) β-blockers and 10.6% (26) used angiotensin type-1 receptor blockers, calcium channel blockers or α-adrenergic blockers (methyldopa).

On evaluating the three main antihypertensive drugs utilized, corrected for the population, the following BP

Table 2 Prevalence of awareness and control by age groups in accordance with sex, socioeconomic and educational level, and BMI

		40–49 (94)		50–59 (203)		60–69 (247)		≥70 (194)	
		Awareness							
Variable	Condition (*n*)	%	*P*	%	*P*	%	*P*	%	*P*
		61.7		75.4		78.1		74.7	0.020
Sex	Male (345)	46.1	0.001	65.6	0.002	79.0	NS	69.2	NS
	Female (393)	81.0		84.1		77.3		78.4	
Socioeconomic level	AB (144)	73.3	NS	71.4	NS	78.8	NS	88.9	NS
	C (300)	51.2		77.9		78.4		73.9	
	DE (294)	66.7		75.9		77.7		72.9	
Schooling (number of years)	0 to 8 (566)	56.5	NS	74.6	NS	78.3	NS	73.0	NS
	9 to 11 (42)	44.4		86.7		75.0		83.3	
	11 or more (130)	71.8		74.1		78.3		100	
BMI (kg/m^2)	Normal (220)	54.6	NS	60.4	0.020	78.3	NS	65.0	0.020
	Overweight (286)	51.4		77.5		76.6		78.3	
	Obese (232)	75.7		81.9		80.0		86.7	
		Control							
		56.9		54.3		49.7		51.7	NS
Sex	Male (345)	50.0	NS	57.1	NS	47.9	NS	57.4	NS
	Female (393)	61.8		52.2		51.5		48.3	
Socioeconomic level	AB (144)	72.7	NS	57.8	NS	65.4	NS	68.7	NS
	C (300)	54.5		58.2		46.2		51.0	
	DE (294)	35.7		43.9		48.3		48.7	
Schooling (number of years)	0 to 8 (566)	38.5	0.032	48.4	NS	48.2	NS	50.0	NS
	9 to 11 (42)	75.0		69.2		44.4		40.0	
	11 or more (130)	71.4		62.8		66.7		80.0	
BMI (kg/m^2)	Normal (220)	66.7	NS	58.6	NS	46.3	NS	57.7	NS
	Overweight (286)	55.6		63.6		49.4		40.7	
	Obese (232)	53.6		45.6		55.8		59.0	

NS, not significant.

Table 3 Mean blood pressure in accordance with the studied and age groups

BP	Case	*N*	40–49	*N*	50–59	*N*	60–69	*N*	70+
SBP	Normal	299	114 (11)	246	118 (12)	128	111 (9)	84	121 (10)
	Unknown	35	143 (16)	50	151 (13)	54	158 (19)	49	160 (22)
	Treated controlled	33	123 (10)	82	123 (10)	95	125 (9)	75	123 (10)
	Treated noncontrolled	25	149 (17)	70	154 (17)	97	155 (20)	70	160 (19)
DBP	Normal		75 (8)		77 (7)		77 (6)		75 (7)
	Unknown		99 (8)		97 (8)		94 (10)		92 (12)
	Treated controlled		81 (5)		78 (6)		78 (6)		76 (8)
	Treated noncontrolled		100 (7)		97 (11)		94 (10)		86 (9)

DBP, diastolic blood pressure; SBP, systolic blood pressure.

control rates were observed: β-blockers – 66.4% (95% CI: 54.7–80.5%), diuretics – 56.6% (95% CI: 45.8–69.6%) and ACEI – 44.8% (95% CI: 36.2–55.3%). Control was significantly greater with β-blockers compared with diuretics and ACEI ($P = 0.004$). There was no significant difference between diuretics and ACEI (P -value = 0.12) (Table 4). The daily mean doses of antihypertensive drugs, more used in monotherapy, by pharmacologic group were atenolol 52.5 mg/day (±26.5), propranolol 64.4 mg/day (±25.6), captopril 56.1 mg/day (±33.0), enalapril 21.1 mg/day (±13.8) and thiazide diuretics 26.2 mg/day (±13.3) (Table 4).

Comparison between the different associations of two pharmacological agents

The most common association used was ACEI and diuretics (47.3% – $n = 107$), followed by diuretics and β-blockers (21.2% – $n = 48$), β-blockers and ACEI (10.2% – $n = 23$) and other associations (21.3% – $n = 48$).

There were no statistically significant differences in respect to the BP control and the most commonly used associations of two pharmacological agents.

Associations of three or more pharmacological agents

The main association was diuretics, ACEI and β-blockers ($n = 27$) with other associations being utilized for 50 individuals in the sample. The small number of individuals and the great variability of associations did not allow statistical analysis.

Table 4 Oral antihypertensive drugs: treatment and control

	Sample (*n*)		Population (%)	
Condition	Treated	Controlled BP	95% CI	*P*
Monotherapy	245	120	50.9 (44.6–58.0)	
Diuretics	64	36	56.6 (45.8–69.9)	0.004[a]
β-Blockers	49	29	66.4 (54.7–80.5)	
ACEI	106	44	44.8 (36.2–55.3)	
Other medications	26			
Two medications	226	121	53.9 (47.3–61.4)	
ACEI and diuretics	107		54.7 (45.4–65.8)	NS
Diuretics and β-blockers	48		67.9 (55.5–83.1)	
β-Blockers and ACEI	23			

ACEI, angiotensin-converting enzyme inhibitors; BP, blood pressure; CI, confidence interval. [a] β-Blockers > ACEI; β-blockers > diuretic.

Cost-effectiveness of monotherapy compared with associations

The cost-effectiveness estimated by the Bootstrap method from the mean monthly values were $87.1 (±7.8) for monotherapy, $159.00 (±15.2) for the association of two pharmacological agents and $294.0 (±39.2) for three or more pharmacological agents.

In the comparison of the main classes of antihypertensives, a lower cost-effectiveness ratio was observed with monotherapy when compared with combinations of pharmacological agents.

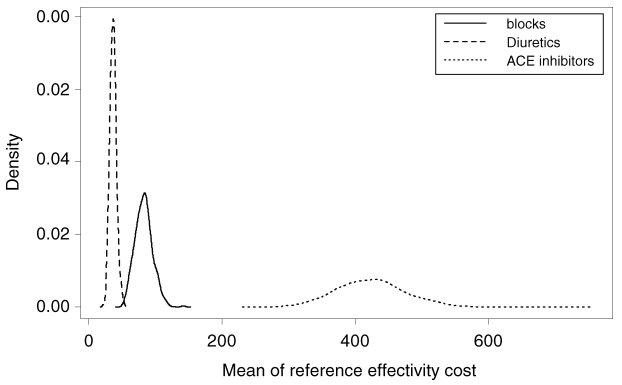
Cost-effectiveness of the main pharmacological agents in monotherapy

Comparing the three main groups of pharmacological agents utilized in monotherapy, the cost-effective ratios were $15.5 (± 2.1) for diuretics, $34.7 (± 5.5) for β-blockers and $176.7 (± 21.8) for ACEI. Thus, the diuretics were more cost-effective in relation to the β-blockers and in particular when compared with ACEI (Fig. 1).

Cost of treatment in relation to the blood pressure control

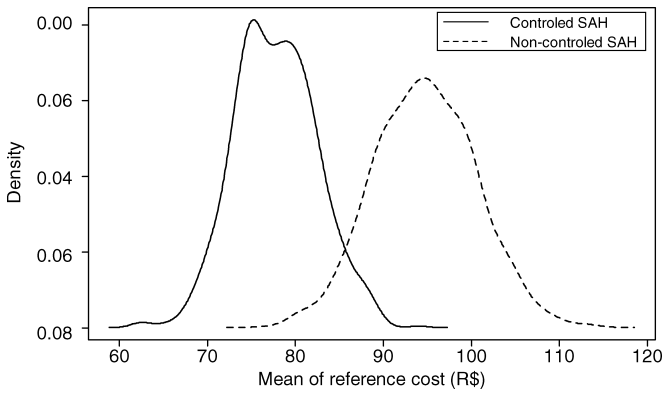
The estimated mean monthly cost of treatment was $32.00 (± 1.7) in the group that controlled their BP

Fig. 1



Mean cost-effectiveness with monotherapy (β-blockers × diuretics × angiotensin-converting enzyme inhibitors) by Bootstrap method. ACE, angiotensin-converting enzyme.

Fig. 2



Mean costs of controlled and uncontrolled high blood pressure (brand-name medications) by Bootstrap method. SAH, systemic arterial hypertension.

pressure, whereas it was \$39.5 (± 2.25) in the uncontrolled group (Fig. 2).

The mean estimated monthly cost for treated individuals would be \$136.7 if they were taking brand-name medicines and \$70.4 with generic drugs.

Discussion

In this study, the levels of awareness and control of hypertension were evaluated in relation to the age, sex, BMI, socioeconomic class and schooling. Additionally, the rates of BP control were analyzed in respect to monotherapy and a combination of pharmacological agents. The Carmela study, comprised individuals ages 25–64 years, living in seven Latino-America cities and the prevalence of hypertension was 18% [20].

In this study, the prevalence of hypertension corrected for the population (≥40 years old) was 43.3%, reaching levels of 65–70% in older individuals.

In Europe the rates of awareness of hypertension vary from 33 to 83%, with percentages of BP control between 11.2 and 41.9%; levels that are considered inadequate [21]. In Asia the percentages of awareness range between 24.6 and 48.5% and those of control between 6.0 and 30.6% [22,23] and in Latin America, these indexes ranged from 20 to 78% and from 18 to 62%, respectively [24,25].

In Brazil it is estimated that, on average, 68.9% of individuals are aware of their hypertensive status and BP control is between 25 and 37.5% of all hypertensive patients [6]. In this study, the percentage of awareness was 72.9% and the rate of control 39.3% among all hypertensive and 52.9% among treated hypertensive patients. These results are comparable with the NHANES and above the national average, probably due to local factors such as educational campaigns, the action of multidisciplinary groups and the availability of medications in government healthcare clinics. These results highlight the great regional variability in developing countries. In fact, this region in São Paulo State presents a higher socioeconomic level compared with many other regions in Brazil. The level of socioeconomic development has an influence on the results. In most African countries, the mean levels of awareness are about 40% except in South Africa where the index reaches 67% and the percentage of controlled individuals varies from 6.2% in Ghana to 66% in whites in South Africa [26,27].

A lower level of awareness was seen in the 40–49-year-old age group, a finding similar to other studies, which observed that the rate of awareness of hypertension increased with age [7]. Individuals tend to consult physicians more for preventive examination and other diseases in the fifth decade of life and this fact probably contribute to a greater detection of hypertension in these individuals.

Some studies concluded that there is an association between the increase in age and lower control of BP, suggesting that hypertensive elderly are treated in a less effective manner with a smaller number of medications [28,29]. However, in this study there was no significant difference between age groups, probably due best adherence to treatment.

The level of awareness of the hypertensive status was higher in women (80.3 versus 64.9%); however, a significant difference in BP control between the sexes was not observed; similar results to NHANES study (2003–2004) [7]. In the current study, the higher rates of awareness of the hypertensive status of women may be explained by gynecological preventive measures, particularly during menopause. In respect to BP control and sex, the results in the literature are variable, some authors reporting differences and others not [7,30].

The level of awareness of obese individuals in this study was higher when compared with normal BMI or overweight individuals. However, the BP control, was similar in the three groups and comparable with the NHANES [7]. It is possible that these results were related to the greater concern of obese individuals about their general health condition due to publicity about the dangers of being obese [31].

However, in clinical practice, a low adherence is observed to treatment either pharmacologic or lifestyle modifications, mainly dietetic adherence, and this may explain the differences between awareness and control of BP. The rate of awareness was similar comparing socioeconomic and educational levels. However, the rate of BP

control was greater for individuals of the higher social classes and those with more years of schooling.

Probably campaigns by the government, universities, media, doctors and healthcare professionals contribute to explain the similar rates of awareness among different social classes and levels of education. On the contrary, lower education levels along with other factors such as obesity, alcohol consumption and sedentarism significantly influence the prevalence and control of hypertension [32]. Other factors are equally important such as limited healthcare access, compliance to treatment and the doctor–patient relationship [32]. Pereira *et al.* [33], in a systematic review of 42 papers in 35 countries, observed higher rates of awareness in all countries, compared with control of hypertension.

Pharmacological treatment

Among individuals under treatment, 46.6% utilized monotherapy and 53.4% a combination of pharmacological agents, results similar to those found in a study by Dias da Costa *et al.* [34] in a Brazilian population who observed 52.9% on monotherapy and 47.1% on combinations. The current study was a cross-sectional design that did not allow an evaluation of complications due to hypertension and/or quality of life. According to other published works, BP control is the main factor responsible for the reduction of complications and thus drugs that effectively reduce hypertension are more advantageous compared to more costly drugs with other actions [11]. On comparing the three major groups of pharmacological agents utilized in monotherapy, with mean doses recommended by guidelines (Table 4), the following percentages of BP control were identified: β-blockers – 66.4%, diuretics – 56.6% and ACEI – 44.8%; there was a significant difference between β-blockers compared with diuretics and ACEI; however, there was no significant difference between diuretics and ACEI.

The potential benefit of combined therapy in BP control has been reported in several studies [35]. In this study, the rates of BP control with monotherapy and combinations were not significantly different, which may be explained by the use of inadequate doses and/or associations and the severity of hypertension. We observed that there is a hiatus between guidelines and consensus and the clinical practice in different aspects of prophylaxis, diagnosis and treatment, results comparable with other studies [36].

Cost effectiveness

BP control and the cost of medications constitute important factors in the analysis of antihypertensive therapy and the prevention of complications.

An analysis of several randomized trials comparing different drug classes showed that reductions in BP had similar reductions in cardiovascular morbidity and mortality rates, reinforcing the conclusion that these benefits depend, to a great extent, on the reduction of hypertension *per se* [11,37,38]. The cost-effectiveness with monotherapy was analyzed in respect to the three main classes of drugs utilized in the study population, that is, ACEI, diuretics and β-blockers. Diuretics had the best cost-effectiveness ratio of these three classes, results comparable with other studies [34]. The cost-effectiveness ratio with monotherapy was $87.00, with an association of two pharmacological agents it was $159.00 and $294.00 with three or more drugs; thus, monotherapy was the most cost-effective.

The mean cost of the medications in controlled hypertension was lower than that for noncontrolled hypertension, both for brand name and generic drugs. These data suggest that more expensive medications were prescribed without considering the therapeutic schemes recommended by the guidelines.

The mean monthly cost of brand-name medications was approximately two times higher when compared with generic drugs. The money spent on medications corresponds to more than 45% of the total direct costs of antihypertensive treatment. Interventions that might reduce the costs through plans of action to conduct hypertension treatment and following the guidelines for disease prevention have a great impact on the economic aspects of hypertension by preventing hospitalization and hypertensive emergencies [39,40].

To reduce the cost of antihypertensive treatment, some measures can be taken including using generic medications (with the utilization of more expensive medications only in specific high-risk groups, such as ACEI in diabetic patients), recommending prescribers to utilize more cost-effective medications and recommending patients and the population the follow nonpharmacological measures to obtain BP control, in particular, in cases of mild or moderate hypertension [41]. Hypertension treatment, without predetermined recommended BP goals, increases the cost without increasing the benefits. The final cost of medications has a great impact on public health as, if 10 million stage 1 or stage 2 hypertensive individuals (mild-to-moderate hypertension) were treated with more expensive medications, the difference in cost would be $2–7 billion annually [42,43].

The transversal outline of this study precludes the relationship between the control rates and the prevalence of cardiovascular diseases.

In spite of the higher awareness and control rates of BP observed when compared with other studies in Brazil and Latin America regions, preventive and educational measures and better adherence to treatment must be

implemented to reduce the growing rates of cardiovascular diseases in our country.

In conclusion, the percentage of awareness and control was high. The prevalence of awareness of hypertension was greater in women and in obese individuals. BP control was better in higher social classes and in individuals with a better education. The best BP control was achieved with the use of β-blockers; however, diuretics were more cost-effective as monotherapy.

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