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Distance travelled in hypertensive subjects: cross-sectional study

Distância percorrida em indivíduos hipertensos: estudo de corte transversal

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RESUMO | INTRODUÇÃO: A hipertensão arterial sistêmica é uma condição clínica ocasionada por diversos fatores que acarretam na elevação dos níveis de pressão arterial de forma sustentada, sendo importante avaliar a capacidade funcional desses indivíduos, visando ter-se um diagnóstico precoce, além de ser um meio de prevenção das repercussões da hipertensão. Um dos instrumentos utilizados é o teste de caminhada de seis minutos (TC6) que é executado em nível submáximo, possibilitando a análise das respostas dos sistemas envolvidos durante as atividades. **OBJETIVOS:** Verificar a distância percorrida dos indivíduos hipertensos. **MATERIAIS E MÉTODOS:** Estudo de corte transversal, com população de hipertensos, entre 30 e 60 anos. O TC6 foi realizado de acordo com protocolo padronizado pela ATS e calculada a distância prevista através da equação preditiva de Enright e Sherrill. Foi utilizado o teste T de Student para comparação das médias de distância e calculado o percentual da diferença entre os valores percorridos e previstos. **RESULTADOS:** 44 sujeitos de ambos os sexos foram avaliados e observou-se média de idade de 48,80±7,08 anos, 56,8% dos indivíduos apresentaram pressão controlada, 81,8% estavam em uso regular da medicação anti-hipertensiva. A média da distância obtida nos indivíduos que alcançaram os valores previstos foi de 503±38,6 metros. Sendo que a maioria dos indivíduos percorreram em média 86,3±7,2% da distância prevista. **CONCLUSÃO:** Indivíduos com hipertensão arterial apresentam diminuição da distância percorrida, independente da pressão arterial estar controlada ou não.

PALAVRAS-CHAVE: Hipertensão. Teste de caminhada de seis minutos. Capacidade funcional.

ABSTRACT | INTRODUCTION: Systemic arterial hypertension is a clinical condition caused by several factors that cause the elevation of blood pressure levels in a sustainable way, it is important to assess the functional capacity of these individuals, aiming to have an early diagnosis, in addition being a means of preventing the effects of hypertension. One of the instruments used is the six-minute walk test (6MWT) that runs in the submaximal level, enabling the analysis of the responses of the systems involved during the activities. **OBJECTIVES:** To determine the distance travelled of hypertensive individuals. **MATERIALS AND METHODS:** A cross-sectional study, with a population of hypertensive patients, between 30 and 60 years. The TC6 was performed according to a standardized protocol by the ATS and calculated the distance provided by the predictive equation of Enright and Sherril. The Student T test was used for comparison of the average distance and calculated the percentage difference between the values driven and laid down. **RESULTS:** 44 subjects of both genders were assessed, with an average age of 48.80±7.08 years, 56.8% of the individuals presented controlled pressure, 81.8% were in regular use of anti-hypertensive medication. The average distance obtained in individuals who have achieved the expected values was 503±38.6 meters. The majority of individuals have traveled on average 86.3±7.2% of the expected distance. **CONCLUSION:** Individuals with arterial hypertension have distance travelled reduced, whether blood pressure is controlled or not.

KEYWORDS: Hypertension. Six-minute walk test. Functional capacity.

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Introduction

High Blood Pressure (HBP) is a clinical condition caused by several factors that lead to a sustained elevation of blood pressure (BP) levels[1]. Due to the high prevalence and low control rates, it is considered as a major modifiable risk factor for cardiovascular diseases (CVD), with estimated direct and indirect costs of US$ 46.4 billion in 2011[2]. Among the risk factors are age, sex and ethnicity, overweight and obesity, salt intake, alcohol intake, sedentary lifestyle, economic and genetic factors[1].

In Brazil, HBP affects about 32.5% (36 million) of adults, making a strong contribution to 50% of deaths from CVD, causing a high impact on the loss of income from work and family income, estimated at US$ 4.18 billion between 2006 and 2015[1]. Additionally, CVD has been the main generator of deaths. In 2017, there were 92,837 deaths due to circulatory diseases. Between 2010 and 2016, a decline in cardiovascular mortality rates from 1,400 to 1,021 related to hypertension could be observed, respectively[3].

The representation of mental abilities, ability to perform daily life activities (DLA), and perform tasks without assistance refers to functional capacity (FC). When an individual has level of physical activity reduced, and consequently FC, it compromises the performance of the DLA's. Functional disability refers to an individual's dependence on performing daily activities and may be related to the reduction in physical performance (FP)[4,5]. FC modifications are predictors of morbidity and mortality in patients with chronic diseases, while early discovery can control the evolution of BP and its consequences[6,7]. This capability can be assessed by using various instruments such as: ergometric test (ET), cardiopulmonary exercise test, bench test, bidirectional distance test, known as ShuttleWalk Test and the six-minute walk test (6MWT)[8].

ET is understood to be a universally accepted resource for diagnosing CVD, being used to determine the prognosis in the evaluation of therapeutic response, stress tolerance and symptoms consistent with exercise arrhythmias, enabling a safe and accurate evaluation for regular physical activity. Because it is a test that has a high cost, not having availability in the Brazilian National Health System (SUS), the six-minute walk test (6MWT) is low cost and the most used[9].

This test has been used in clinical practice since the 1960s and is considered as a submaximal test that globally examines various systems involved during the practice of exercises, such as musculoskeletal, cardiovascular and respiratory systems. The objective is to stipulate the distance travelled in a flat path, besides correctly portraying the functional capacity of individuals to perform their day-to-day tasks[10,11].

Considering the existence of FC alterations in CVD, it is possible that this parameter may be altered in the hypertensive disease. The control of BP as well as its treatment are essential to reduce cardiovascular events, and once it is observed that individuals with hypertension have some impact on the functional capacity[6], early identification of impacts on FC may function as a prognostic factor for morbimortality. Investigating this association can be a way of preventing the BP complications, early diagnosis, and consequently guiding changes in life habits. Therefore, this study aims to verify the distance travelled from hypertensive individuals.

Methodology

It is a cross-sectional study, through database analysis,which collection was carried out in the Bahian Assistance Teaching Ambulatory (ADAB) and Full Life Community Complex (CCVP) linked to Bahian School of Public Health (EBSP), held in the period from March 2013 to December 2017.

Criteria for the Inclusion

Individuals with medical HBP diagnosed (SBP≥140mmHg and/or DBP≥90mmHg) validated by repeated measurements in ideal conditions on two or more occasions, and confirmed by measurements outside the office (Ambulatory Monitoring of BP-AMBP)(12), body mass index (BMI) up to 34.9kg/m2, in regular use of antihypertensive medication as indicated, with age range between 30-60 years, of both sexes and residents in the metropolitan region.

Criteria for the Exclusion

Musculoskeletal or neuromuscular disorders that significantly limit walking, smoking individuals, respiratory diseases (asthma, bronchitis, recent pneumonia – in the last 6 months), allergies, mental disorders, depression, renal failure, pregnancy and diabetes mellitus associated with HBP and a history of previous cardiovascular events (myocardial infarction, heart failure, unstable angina, peripheral arterial disease) and previous orthopedic problems, detected in a medical record or with referred diagnosis.

Instruments used

In the evaluation, the following tools were applied: questionnaire with personal information and socio-demographic data, habits of life and health, anthropometric data, weight and height.

For 6MWT performance was utilized: 30m corridor, chronometer, digital blood pressure meter (Mark Omron, model HEM-742), pulse oximeter (Mark MD 300C1), sledge, two traffic cones, adhesive tape, a chair and modified Borg scale to measure the subjective perception of effort.

To perform the 6MWT, according to standard protocol, individuals were instructed to walk alone within six minutes time, in a 30 meters long corridor, with markings in every 3 meters without obstacles in the course. He or she should make a curve where it was demarcated with a cone, following its own rhythm.The examiner used incentive words such as "You are doing well" or "Continue, good work"in a neutral and standardized manner in the second and fourth minutes of the test[13,14].

Guidelines were oriented to individuals, such as not talking during the test, walk slowly or even interrupting the test if he or she felt any discomfort, such as dyspnea, chest pain, dizziness or leg pain. BP was measured at the beginning and the end of the test, heart rate (HR), oxygen saturation (O2Sat), as well as modified BORG dyspnea scale were checked at the beginning, during the test and at the end of the 6MWT. The route was shown to the individual by the examiner[13,15].

In the literature, some reference equations were found for the distance travelled prediction to 6MWT, and it was applied to define the percentage of the difference between the obtained and predicted values[6,16]. The equation of Enright and Sherrill was used[15].

Calculation of the sample

Based on the study developed by Dia set al.[11], in which a distance standard deviation (SD) was found in control group of about 45 meters, the sample size was calculated for a paired comparison of two means, considering a distance SD travelled about 10 meters to the expected distance and about 45 meters to the obtained distance, with a difference between the groups averages of 20%, a 5% significance level, power test of 80%, in a bicaudal hypothesis, totaling 34 pairs of individuals with 68 observations. The calculation was performed on the WINPEPI® calculator(Published in Epidemiologic perspectives &Innovations).

Data Analysis

The variables analyzed in this study were: age (years), sex (dichotomous), marital status (married/stable marriage, separated/divorced, single, widowed), education (years of study, sub divided into 1-4 years, 5-8 years, 9-11 years and 12 years and more),skin color (according to IBGE: black, white, brown, yellow, indigenous, other), smoking (never smoked, smoker, former smoker), alcohol consumption (dichotomous). For the accomplishment of 6MWT, variables analyzed were: distance travelled (meters), BP (mmHg), HR (bpm), RR (ipm), O2Sat (percentage) and effort perception (numeric).

Mean and SD were utilized for descriptive analysis of the variables age (years), functional capacity (distance travelled), BP, HR, RR and effort perception, since the distribution was normal. Categorical variables sex, marital status, education, skin color, smoking, alcohol consumption were described in absolute values and percentage.

To verify sample normality, Shapiro-Wilk test was performed on the outcome variable. The variable functional capacity was recategorized from the predicted values: it reached the predicted distance when the obtained distance was equal to or greater than the expected distance; or did not reach the expected distance when the values obtained were below the predicted values, and the Student's T test was applied for comparison of distance travelled averages, In addition, the percentage of the difference between the values obtained and predict was analyzed. Data regarding quantitative research were organized using the software Statistical Package for Social Sciences (SPSS), version 17.0 for Windows. The database and analysis will be in the hands of the researchers until the end of research.

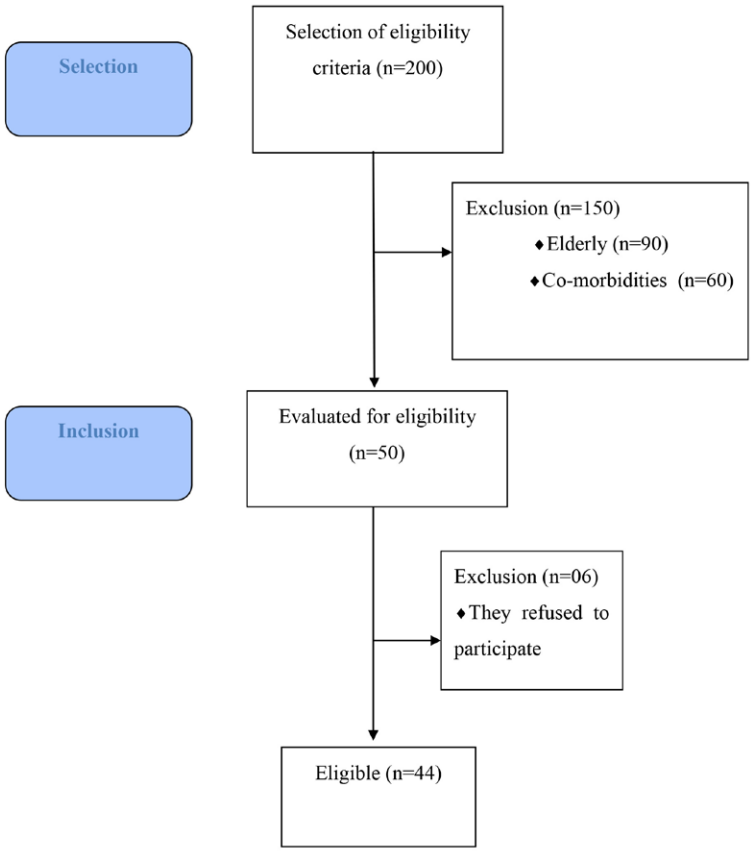
Ethical aspects

This article was approved by the Bahian School of Medicine and Public Health Ethical Committee, CAAE nº 16952113.5.0000.5544. To participate in the research it was necessary to read and sign written in formed consente (WIC), adapted according to the profile of the participants. This study is also registered in the ClinicalTrials under protocol NCT 02401516.

Results

The selection of participants after eligibility criteria evaluation was composed of 200 individuals, of which 150 were excluded because they did not meet inclusion criteria. Of the 50 left individuals, 6 refused to participate in the study. The sample consisted of 44 participants (Figure 1).

Figure 1. Flowchart for definition of study participants



The mean age was 48.80±7.08 years, mean height of 161.16±8.18 cm, mean weight of 75.70±10.63kg, predominance of female gender (75%), married (56.8%), with good level of education of 12 years or more of study (63.6%), black skin color (50%) (Table 1).

Table 1. Sample Characteristics regarding to sociodemographic, anthropometric and clinical data. Salvador-Ba. 2018 (n=44)

Variables	Average±SD
Age (years)	48.80±7.08
Height (cm)	161.16±8.18
Weight (kg)	75.70±10.63
BMI (Kg/m²)	29.22±10.63
Sex	**n (%)**
Female	33 (75.0)
Marital Status	
Married/stableunion	25 (56.8)
Single	13 (29.5)
Widower	2 (4.5)
Separated/divorced	4 (9.1)
YearsofStudy	
Until 4	1 (2.3)
5 – 8	5 (11.4)
9 – 11	10 (22.7)
12 or more	28 (63.6)
SkinColor (IBGE)	
Black	22 (50.0)
Brown	19 (43.2)
White	2 (4.5)
Yellow	1 (2.3)

IBGE: Brazilian Institute of Geography and Statistics; SD: Standard Deviation; n: Number of Individuals;

In relation to smoking, 34 (77.3%) reported that they never smoked, 19 individuals (43.2%) did not consume alcohol, 36 subjects (81.8%) were using anti-hypertensive medication regularly, and the medication most used by 26 (59.1%) was II Angiotensin receptor blockers, 25 subjects (56.8%) had controlled blood pressure, and 28 (63.6%) did not engage in regular physical activity. Individuals had SBP, DBP, HR, RR, O2Sat and perceived effort averages at the beginning of the test of 151.08±22.40, 91.52±14.68, 74.87±11.04, 25.3±4.59, 96.73±1.90 and 3.11±2.30, respectively (Table 2).

Table 2. Sample characteristics of life and health habits data and clinical 6MWTparameters. Salvador-Ba. 2018 (n=44)

Variables	n (%)
Life and Health Habits	
Smoking	
Neversmoked	34(77.3)
Smoker	1 (2.3)
Formersmoker	9 (20.5)
Consumption of Alcohol	
Yes	19 (43.2)
Anti-hypertensive medicinal product	
Yes	36 (81.8)
Type of medication	
Thiazidediuretic	15 (34.1)
Beta blocker	15 (34.1)
ACE inhibitors	2 (4.5)
ARB	26 (59.1)
Calcium channel blockers	8 (18.2)
SAA	4 (9.1)
BP Classification	
Controlled hypertension	25 (56.8)
Regular physicalactivity	
No	28 (63,6)
6MWT Clinical Parameters	**Average±SD**
PAS	151.08±22.40
PAD	91.52±14.68
FC	74.87±11.04
FR	25.3±4.59
SpO_2	96.73±1.90
BORG	3.11±2.30
Distance travelled - Men	541.03±54.71
Distance travelled - Woman	500±45.70
Distance travelled	510.25±60.73
Predicted distance Enright and Sherrill	559.27±59.80

ACE:Angiotensin converter enzyme; BRA:II angiotensin receptor blockers;AAS:AcetylSalicylic acid; BP:Blood pressure; SBP:Systolic blood pressure; DBP:Diastolicblood pressure; HR:Heart rate; RR:RespiratoryRate; O2Sat:Oxygen Saturation; BORG:Scale for Effort Perception; SD: Standard Deviation; n:number of Individuals;

The average distance for men was 541.03±54.71 meters, and women covered 500±45.70 meters. In the comparison of distance travelled with predicted distance, the averages were 510.25±60.73 and 559.27±59.80 meters, respectively, with no statistical significance (Table 2).

Table 3. Association between distance travelled, blood pressure category, use of beta-blockers and obtained distance categories. Salvador-Ba. 2018. (n=44)

Variables	n	Distance travelled	p-value*
Category of Hypertension*		**Average±SD**	
Controlled	25	508.83±56.10	0.84
Uncontrolled	19	512.11±44.11	
Beta blockerusage*			
Yes	15	506.78±46.03	0.75
No	29	512.04±53.7	
Obtained distance categories*			
Reached predicted distance	19	539±80	0.05
Did not reach predicted distance	35	503±38.6	

DP: Standard Deviation; n: Number of Individuals; p: significance; *Student TTest;

Individuals with controlled hypertension presented an average distance of 508.83±56.1 meters and 512.11±44.11 meters for uncontrolled hypertension. Considering a possible effect of beta-blockers on FC, it was observed that individuals using beta-blockers had an average of 506.78±46.03 meters, and individuals who did not use had an average of 512,04±53.7 meters, with no statistical significance. The mean obtained distance in the individuals who did not reach the expected values was 503±38.6 meters, and the majority of individuals covered 86.3±7.2% on average of expected distance (Table 3).

In this sample there was a predominance of 28 (63.6%) individuals who did not practice physical activity on a regular basis. Knowing that in this population a reduction in 6MWT obtained distance may occur, consequently a reduction in functional capacity, and such a condition occurs due to the inadequate performance of the musculoskeletal systems.Subgroup analysis was performed to identify if sedentary lifestyle could be a result-modifying study.

Table 4. Comparison of anthropometric and clinical variables between sedentary and non-sedentary individuals. Salvador-Ba. 2018. (n=28)

Variables	Sedentaryn=18	Non-sedentary n=10	p-value*
Sex			
Female	13 (72.2%)	8 (80.0%)	0.51
Smoking			
Neversmoked	13 (72.2%)	7 (70.0%)	0.60
Smoker	1 (5.6%)	---	
Formersmoker	4 (22.2%)	3 (30.0%)	
Consumption of Alcohol			
Yes	9 (50%)	5 (50%)	0.65
Anti-hypertensive medication			
Yes	15 (83.3%)	7 (70.0%)	0.36
Type of medication			
Thiazidediuretic	5 (27.8%)	4 (40.0%)	0.40
Beta blocker	6 (33.3%)	2 (20.0%)	0.39
ACE inhibitors	1 (5.6%)	1 (10.0%)	0.60
ARB	11 (61.1%)	4 (40.0%)	0.25
Calcium channel blockers	1 (5.6%)	1 (10.0%)	0.60
SAA	1 (5.6%)	1 (10.0%)	0.60
BP Classification			
Controlled hypertension	11 (61.1%)	8 (80.0%)	0.28

ACE:Angiotensin converter enzyme; ARB: II angiotensin receptor blockers; SAA:Acetyl salicylicacid; BP:Blood pressure;n:number of Individuals; p: significance; *Chi_Quadrate;

The variables of interest that could present some modifying factor by sedentary lifestyle are arranged in tables 4 and 5, in which it is observed that there was no statistical difference between sedentary and regular activity practitioners.

Table 5. Comparison of variables related to the distance travelled between sedentary and non-sedentary individuals. Salvador-Ba. 2018. (n=28)

Variables	Sedentary n=18	Non-sedentary n=10	p-value*
Age (years)	47.9±5.3	44.6±9.3	0.32
BMI (Kg/m²)	28.9±4.3	27.7±3.9	0.43
6MWT Parameters			
SBP	148±23	153±18.7	0.55
DBP	92.7±15.9	88.1±14.1	0.45
HR	75±12	76±10	0.89
RR	21.7±4.4	22±2.6	0.91
O_2Sat	97.5±0.7	97.7±0.7	0.47
BORG	1.83±2.15	1.9±2.42	0.94
Distance travelled	499.3±56.5	494.5±26.5	0.80
Predicted distance*	572.3±57.5	590.7±62.1	0.44

SBP:Systolic Blood Pressure; DBP:Diastolic Blood Pressure; HR:Heart Rate; RR:RespiratoryRate; O2Sat:Oxygen Saturation; BORG:Scale for Effort Perception; Predicted Distance by Enright and Sherrill formulae;n:number of Individuals; p: significance; *Student T-Test

Discussion

This research aimed to verify the distance travelled from hypertensive individuals, presenting results compatible with the literature. In general, individuals with hypertension are already affected by distance travelled when compared to expected distance for each person, regardless of whether blood pressure is controlled or not. Most of participants (79.54%) were unable to reach the expected distance and the beta blocker was not a modified factor forresults found. However, in spite of this difference, they covered about 86.3% of the expected distance, which may not present clinical relevance.

This fact may be associated with increased peripheral vascular resistance (PVR), and its derivations. The increase in PVR in hypertension results from arterial vasoconstriction, which can cause muscle hypoperfusion for a long time if the pattern is maintained. In conditions of restriction and increase of metabolic demand, hypertension can be a factor that causes the reduction of the muscular nutritional intake, and can compromise the muscular contractility, affecting individuals functional capacity[8].

The study developed by Silveira et al.[7] has analyzed 10 hypertensive men with a mean age of 48.9±5.95 years, who did not practice regular physical activity, covering approximately 593,36±61.36 meters, obtaining a distance travelled greater than individuals of the same sex, despite the average age being similar in the present investigation.

In the study developed by Ribeiro et al.[17], performed with 15 hypertensive women, with a mean age of 63.1±4 years, they covered 468±4 meters. Pedrosa et al.[4] presents in their study 32 hypertensive women, with an average age of 65.4±5.4 years, covered 428±85 meters of distance travelled.These distances are smaller than that of the present study when compared with individuals of the same sex. Ferreira et al.[18], in their study with 18 hypertensive individuals of both sexes, aged 54 to 83 years, covered a distance travelled of 432.02 meters, obtaining a distance travelled smaller than that of the present study, performed with individuals of both sexes, however, age can be an explanation for this divergent data.

It is suggested that modifications in the functional capacity of hypertensive individuals are related to the mechanisms that regulate the big and small arteries[8]. The resistance of the arterioles depends mainly on its caliber, in the hypertension occurs the narrowing of the vessels, which increasesheart contractility that regulates vessel diameter, causing an increase of the PVR, hindering the transport and the permeability for the energy and nutritional arrival of the muscles[8,19].

In a secondary analysis, it was observed that the presence of a greater number of sedentary people in this sample was not able to influence or modify results regarding the 6MWT. The results suggests that distance travelled values at 6MWT below the predicted values are due to the cardiovascular condition.

The percentage of distance travelled in relation to the predicted distance may not be of clinical relevance in the present study. On the other hand, considering the HBP risk factor for cardiovascular diseases, in which there is a systemic progression of morbidity, it is important to consider on a possibility of follow-up at regular basis for those individuals, with systematic evaluations of FC, to identify when FC changes may bring significant clinical consequences.

Based on these data, it is suggested that individuals with HBP are monitored regularly and that 6MWT can be inserted as an evaluation of functional prognosis, so that a clinically significant minimum difference and a possible cutoff point can be determined for prognosis of comorbidities.

This research had as limitation the greater number of women in the sample, since they have the tendency to seek for health services more frequently than men. The study presented a low risk of bias, since there was no loss of participants or data for the main outcomes. The main outcomes were analyzed according to the proposed outcome, as well as it was those variables with potential outcome modification.

Conclusion

Individuals with hypertension have decreased distance travelled, regardless of whether the blood pressure is controlled or not.

Author contributions

Oliveira JS wrote the manuscript. Góes ALB contributed to the research supervision, revising and writing of the manuscript.

Competing interests

No financial, legal or political conflict involving third parties (government, companies and private foundations, etc.) has been declared for any aspect of the work submitted (including but not limited to grants and funding, participation in advisory board, study design, manuscript preparation, statistical analysis, etc.).

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