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Curtailing the Burden of Resistant Hypertension among some African Americans within a Specific age group through a Specific Treadmill Exercise Regime

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ABSTRACT

Background: Previous studies showed that aerobic exercise actually curtails oxidative stress and decreases BP but little to no studies showed which racial ethnicity benefited most from conditioning treadmill exercises. The purpose of this study is to increase awareness of supportive care in the form of treadmill exercise for African Americans of a specific age group with resistant hypertension. We hypothesized that a structured exercise training program along with reducing regular three or four medications after the study improves symptoms and quality of life for African American patients within a specific age group with resistant hypertension.

Methods: Total number of recruited patients were one hundred and eighty (180) between ages eighteen-forty-eight (18-48). Ninety patients (90) were in the experimental group while ninety (90) were in the non-experimental/control group. Forty-five (45) males each were in both research groups while forty-five (45) females each were in both the experimental and control group. Weight of participants was between 200-230 pounds. Data was collected from National in Patient sample (NIS) HCUP and extracted using SAS ver. 9.4 from ICD-9 for 2016. Control group used the treadmill exercise one to two days within the week for about 45 minutes while the experimental group exercised at least 3-5 days on treadmill for 45 minutes and attained accumulated weekly mileage of ≥ 2.

Results: The study showed that decreasing blood pressure from ≥130/80 to normal bp of <120/80 mmHg for African Americans of a specific age group was statistically significant (p-value for AA males and females respectively 0.0166 and 0.0125. That is; $p<0.05$). Conclusion; our structured exercise training program plus medication adjustments improved symptoms and quality of life for African American patients with resistant hypertension within a specific age and weight group.

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Introduction

Resistant hypertension (RH) is defined as elevated blood pressure (BP ≥130/80) in a patient despite concurrent use of ≥ 3 antihypertensive drug classes mainly; a long-acting calcium channel blocker, angiotensin-converting enzyme inhibitor (ACE-I) or angiotensin receptor blocker (ARB) and a diuretic mainly thiazide diuretic. RH also entails lowered BP attainment on ≥4 antihypertensive agents. Hypertension is systolic blood pressure

(SBP) value of ≥ 130 mmHg and/or diastolic blood pressure (DBP) of ≥ 80 mmHg. American College of Cardiology (ACC) classifies the following; normal: SBP less than 120 and DBP less than 80mmHg, elevated: SBP 120 to 129 and DBP less than 80mmHg; stage 1 hypertension: SBP 130 to 139 or DBP 80 to 89mmHg; stage 2 hypertension: SBP greater than or equal to 140 mmHg or greater than or equal to 90 mmHg [1]. A major modifiable risk factor for cardiovascular diseases is hypertension [1-3]. The ESC/ESH classifies hypertension in all individuals of ages 16 years and above as; normal: SBP less than 120mmHg and DBP less than 80mmHg; pre-hypertension: SBP 120 to 139mmHg and DBP 80 to 89mmHg; Stage 1 hypertension: SBP 140 to 159mmHg and DBP 90 to 99mmHg; Stage 2 hypertension: SBP greater than or equal to 160mmHg and DBP greater than or equal to 100mmHg [4]. The cause of hypertension is mainly idiopathic; however, many studies has linked certain risk factors to it like atherosclerosis of which African American males risk increases after age 45 with those of females increasing by age 55. High blood pressure and hypertension (the disease) are both pertinent modifiable risk factors for cardiovascular risk. Treatment layout entails lifestyle modifications as well as drug therapies designed to put blood pressure in check while curtailing overall cardiovascular risk [4-7].

Resistant Training and Aerobics

Resistance training cut down levels of C-reactive protein (CRP) in the blood of African-Americans while this acute phase reactant (CRP) did not curtail in White and Caucasian men [8]. As a marker for systemic inflammation, levels of CRP increase after injury or infection with chronically high levels sometimes being linked to heart disease and hypertension [8]. Aerobic exercises bring-down oxidative stress, decreases CRP in Black males, while also decreasing 8-isoprostane (a marker for oxidant stress involved in reactive oxygen speciation) and MMPs (assists in blood vessel remodeling after injury/infection) levels in exercising African Americans. These markers stayed same in Whites and Caucasians despite physical activity [9]. Curtailing of hypertension by as much as 5-7 mmHg is the beneficial effect of exercise in both systolic and diastolic blood pressures [10-14]. It is pertinent to note that immediate curtailing in blood pressure after exercise could stay longer for almost 24 hours hence its' name post-exercise hypotension with most obvious effect seen in those patients with persistent high baseline blood pressure [11, 15,16].

Mechanisms of Blood Pressure Reduction

Changes in oxidative stress, endothelial function, body mass, inflammation, renin-angiotensin system activity, renal function, arterial compliance, parasympathetic activity and insulin sensitivity [10]. Underlying mechanisms of blood pressure curtailing with exercise plus associated outcomes continue to garner much needed investigation with several studies restricted by size as well as marked heterogeneity [17].

External Factors Affecting Blood Pressure

Non medication compliance, diets with high salt content, red meat that is not well done, high lipids and fructose as well as stimulants/substances like cocaine, caffeine, natural/herbal supplements and alcohol just to name a few. Factors like stress, sedentary lifestyle, smoking and white coat syndrome can also bring about hypertension [18]. In some countries like China, 60% of resistant hypertension patients are over the age of 65 years old [19]. Secondary/external causes has to be curtailed to achieve controllable blood pressure [20]. In patients with resistant hypertension and uncontrolled blood pressure despite potent diuretic therapy, American Heart Association (AHA) suggests adding a mineralocorticoid receptor antagonist like (spironolactone or eplerenone) or a potassium-sparing diuretic (like amiloride, triamterene) as alternatives if a mineralocorticoid receptor antagonist cannot be used [20].

Other options include alpha-1 antagonists such as doxazosin or direct vasodilators (hydralazine or minoxidil). The direct vasodilators hydralazine and minoxidil are generally reserved for patients who remain hypertensive despite trying the main antihypertensives. A multidrug therapy including angiotensin - converting enzyme inhibitors, angiotensin II receptor blockers, beta blockers, diuretics, long-acting calcium channel blockers such as Amlodipine or Nitrendipine that are derivatives of dihydropyridine as well as mineralocorticoid receptor antagonists has been demonstrated to be effective in resistant hypertension treatment [21]. Resistant exercise can lower blood pressure like some medications do but treadmill exercise is a better option to controlling resistant hypertension [22]. Physical activity and/or exercise are shown to delay development of hypertension when started early. Both aerobic and resistance exercise have been postulated to reduce blood pressure (BP) effectively with 40 minutes, 4 times/week of aerobic exercise but does not show for how many weeks and by how much reduction [23].

Resistance hypertension is significantly associated with elderly female gender [24,25]. In a study that included 515 patients, 12% of the total patients (n= 62) had resistant hypertension with most of these being elderly females with higher body mass index, those on painkillers and those noncompliance to dietary recommendations. Several studies have also concluded that; "Only 25% of all African Americans with hypertension and fewer than 50% of those receiving drug treatment attain a blood pressure <140/90 mm Hg. These control rates are some-what less than in white Americans" [26]. The hypothesis/goal is to show up to three (3) antihypertensive medications plus treadmill exercises significantly controls blood pressure for resistant hypertensive African Americans without them needing a fourth medication to control their blood pressure.

Methods

This study entailed a total number of one hundred and eighty (180) patients aged eighteen-forty-eight (18-48) with (104 males and 76 females). Data was sampled or collected from National In Patient sample (NIS) HCUP and was extracted using SAS ver. 9.4 from ICD-9 for 2021. Patients were compliant with treatment and went to their physicians to have their medications adjusted after the study. Weight stayed within the same range. Statistical analyses conducted included; probability, mean, degree of freedom (df), Chi square and frequency with focus on probability ad chi square. The treadmill exercise went for about twelve (12) weeks with target month being June-August 2021. The first seven weeks showed no improvement however, the recorded final five weeks which is represented on Table 1; (weeks 7-12) produce results. The adjusted risk was minimized to 32% for each participant with 7.9 miles increase in exercise capacity for at least five weeks with average weekly mileage reporting of about 2.0 miles. Inclusion criteria; control group, only African Americans aged 18-48 who self-reported treadmill exercise, those on at least three antihypertensive medications and had no other comorbidities, those that were active for at least 3-5 days on treadmill for 45 minutes and attained accumulated weekly mileage of ≥ 2. Exclusion criteria; patients with resistant hypertension along with secondary causes of hypertension like Cushing syndrome, pheochromocytoma, renal parenchymal disease and renovascular disease or even with family history of such illnesses were excluded. Female African Americans

of the same age group were excluded. African Americans aged 49 and over or less than 18 years of age with resistant hypertension were excluded. Patients taking more than 30 seconds break time while doing treadmill exercising were excluded.

Discussions

Table 1 sampled results from start to finish of the treadmill for the final five (5) weeks of the twelve-week window. Results were mixed, inconsistent with little to no changes in mean blood pressure readings. This shows that consistent treadmill exercise for a particular regime is more effective when followed for at least twelve weeks. Participants were healthy with little to no family history of hypertension and other comorbidities. Frequencies were recorded. Total females were 45 and males were 45 making a total of 90 participants for the experimental group.

Table 2 had the data for mainly the control group. This group showed very little to no changes in mean blood pressures from the start of the twelve-week experiment to the end of the twelfth week. Probability for the control group total for both male and female was $p \geq 2.370$. Table 3 has the values for the mean blood pressures for both gender from the start of the program in week 1 to the finish of the program for week 12. Average blood pressure readings were recorded after adding total blood pressure readings for males and dividing by total sample of for example males which was 45. This was repeated for females as well as also in the control group. Table 4 was the control group mean blood pressure. For males, no change was observed as start and finish; that is, week 1 to week 12 mean blood pressure (MBP) was 130/80 and for females; start of week 1 was 129/80 and by the end of week 12 or at week 12, there was still just a drop by one or systolic blood pressure in the numerator leading to; 128/80.

Results Section

Table 1: Treadmill Exercise by Gender

Frequency Percent Row Pct Col Pct	Table of experimental group Final five weeks of treadmill exercise						
	Gender	7&8	9	10	11	12	Total
	Females	1 0.56 1.32 50.00	8 8.89 21.05 61.54	19 25 59.21 46.39	10 4.44 10.53 33.33	7 3.33 7.89 19.35	45 42.22
	Males	1 0.56 0.96 50.00	6 5.56 9.62 38.46	17 28.89 50.00 53.61	12 8.89 15.38 66.67	9 13.89 24.04 80.65	45 57.78
	Total	2 1.11	14 14.44	36 53.89	22 13.33	16 17.22	90 100.00

For example; Female; Frequency
Percent
Row Pct
Col Pct

Table 2: Control Group Data

Frequency Percent Row Pct Col Pct	Table of non-experiment group Final five weeks of treadmill exercise						
	Gender	7&8	9	10	11	12	Total
	Females	9 0.56 1.32 50.00	9 8.89 21.05 61.54	9 25 59.21 46.39	8 4.44 10.53 33.33	10 3.33 7.89 19.35	45 42.22
	Males	9 0.56 0.96 50.00	9 5.56 9.62 38.46	9 28.89 50.00 53.61	10 8.89 15.38 66.67	8 13.89 24.04 80.65	45 57.78
	Total	18 1.11	18 14.44	18 53.89	18 13.33	18 17.22	90 100.00

Table 3: Experimental Mean BP

Gender of AA	Analysis for;	Mean BP at Start average	Mean BP at Final/Finish average
	Experimental group		
Males	45	130/80	125/80
Females	45	128/80	122/80
PROPORTION THAT ACHIEVED STANDARDIZED BP			
Males			
120/80; 2/45 x 100 = 4%			
125/80; 43/45 x 100 = 95.56%	Average; 125/80		
Females			
120/80; 6/45 x 100 = 13.33%			
123/80; 39/45 x 100 = 86.67%	Average; 122/80		

Table 4: Blood Pressure Measurements for Non-Experimental Group

Gender of AA	Analysis for;	Mean BP at Start average	Mean BP at Final/Finish average
Control group			
Males	45	130/80	130/80
Females	45	129/80	128/80

For Table 5, our target blood pressure to define normal blood pressure was; ≤ 125/80 for both male and female genders. When that was obtained, we averaged males mean blood pressure and did the probability and then did the same for female blood pressure and obtained the average blood pressure readings. For the Control or non-experimental group, total probability for both males and females were $p = 2.370$ with $p \geq 1.195$ for males while females earned; $p \geq 1.175$. For the experimental group African American (AA) males, p-value ≤ 0.0163 while that of female probability was $p \leq 0.0125$. Dealing with nominal values where we have to categorize into high blood pressure to low pressure, chi-square test helped us compare observed results of monitoring treadmill exercise with expected results. Our study noted the benefits of exercise but modified the exercise regime to better fit a particular research focus which is males and females between ages 18-48 with little to no comorbidities of family history of hypertension but who had resistant hypertension and were on at least more than three anti-hypertensive medications to achieve desired blood pressure levels.

Table 6, just shows the income level. People who did their daily work, had good insurance, could afford modification changes when referred to specialist and volunteered to share their income levels so in case they may need more days of training, calling off from work would not be an issue. Miles mean, standard deviation as well as minimum and maximum levels were also on Table 6.

Table 5: Analysis of Data

Sample Size = 180

Statistic	DF	Value	Prob
AA Male Chi-Square	4	12.1398	0.0163
AA female Chi-Square	4	12.7607	0.0125
Control group total AA gender Chi-Square	4	11.6038	2.370
Phi Coefficient		0.2597	
Contingency Coefficient		0.2514	
Cramer's V		0.2597	

Table 6: Income Average of Participants and the Miles Run on Treadmill

2 Variables:			Income Miles			
Simple Statistics						
Variable	N	Mean	Std Dev	Sum	Minimum	Maximum
Income	180	53720	16507	9669524	29562	104581
Miles	180	103.19444	51.86360	18575	21.00000	360.00000

The purpose of chi-square test is to determine if a difference between observed data and expected data is due to chance, or if it due to a relationship between the variables being studied. The degree of freedom in a chi square distribution is also its mean. Our data was drawn from a large enough sample and from independent variables. It was raw and mutually exclusive. Our p-value < 0.05 shows our hypothesis of using treadmill in our specified training regime to help reduce anti-hypertensive medication over-dependence in resistant hypertensive patients should not be rejected. This means we reject the null hypothesis that treadmill exercise within our regime does not make any difference as to whether patients with resistant hypertension still need to be on more than three anti-hypertensive medications.

Disease-associated morbidity and mortality including atherosclerotic cardiovascular disease (ASCVD), stroke, heart failure (HF), and renal insufficiency, increase with higher levels of SBP (systolic blood pressure) and DBP (diastolic blood pressure). Over the last three decades, aggressive treatment of hypertension resulted in a substantial decrease in death rates from stroke and coronary heart disease (CHD) [27]. BP rises with age. Our study considered comorbidities like being overweight/obese, increased dietary sodium intake, decreased physical activity, increased alcohol consumption, and lower dietary intake of fruits, vegetables, and potassium. Patients reported little to no improvement with two or fewer exercises per week. Patients took their regular time and dose of medications while still exercising within specified time frame. Patients taking more than three minutes break time while exercising were not included.

All patients sampled had no secondary causes of hypertension like Cushing syndrome, pheochromocytoma, renal parenchymal disease and renovascular disease. Our patients did not have secondary causes of resistant hypertension like inaccurate BP measurement, inadequate regimen, nonadherence, ingestion of exogenous substances for example decongestants, oral contraceptives, or were not on any other kinds of medications that could increase their blood pressure. Drug withdrawals like alcohol, cocaine, opioid analgesics were not reported. Rebound increases in BP were not reported and substance abuse medications like cocaine and other sympathomimetics drugs like amphetamine, phencyclidine were not reported. "Black and Hispanic adolescents report less physical activity on average than do white adolescents and are more likely to report no physical activity on any day in the past week" but our study showed that African Americans or Blacks who followed the exercise regime for twelve weeks and had resistant hypertension had their blood pressure decreased by double therapy with/without a third medication in order to achieve adequate blood pressure readings [28,29].

Limitations to Study

No information was provided about the incline percentage. The study did not show whether patients used hand rails while exercising. Patients were not grouped in a particularly facility prior to working out on the treadmill but lived regular lives, only self-reporting for exercise after their activities of daily living like job/work. Nonetheless, our study reported significant reduction of compliant African Americans on both medical therapy and a specific treadmill exercise regime to be statistically significant than medication alone for the management of their resistant hypertension.

Conclusions

A study conducted only on populations of middle-aged men of European descent and hence its' why it is limited, showed that; age, ethnicity and sex did not appear to alter blood pressure response to exercise [30]. Other studies also reported; 20-25% of people with hypertension were non-responders as their blood pressure readings after exercise did not reduce [31]. Most of these studies were properly investigated and our study was adjusted to make sure the focus was on resistant hypertension African Americans within a specific age group who did not have secondary causes of hypertension. Our results showed that African Americans between the ages of (18-48) who complied with medication requirements form their primary care providers along with treadmill exercise regime for about 45 minutes continuously on regular speed with about three minutes breaks in-between for 3-5 days a week for about twelve weeks were able to attain normal blood pressure readings. Our results were statistically significant.

Declarations and Checklist

Funding: this study is and has not been funded by anyone school, organization, or any parties. (Non-applicable).

Conflict of Interest: The authors declare that they have No Conflict of Interest. (non-applicable)

Complies with ethical standards (applicable)

i. Consent to participate (verbal to participate)
ii. Consent for publication (non-applicable)
iii. Availability of data and material (NIS; HCUP)
iv. Code availability (non-applicable)
v. Author's contributions

Data Collection and Interpretation Process

National (Nationwide) Inpatient Sample (NIS) is part of a family of databases and software tools developed for the Healthcare Cost and Utilization Project (HCUP). The NIS is the largest publicly available all-payer inpatient healthcare database designed to produce U.S. regional and national estimates of inpatient utilization, access, cost, quality, and outcomes.

1. Introduction, references and extraction of patient's information was acquired from NIS HCUP databases by (Dr. Raymond Junior Patrick Cadet, Dr. Nkechi Ihezie and Dr. Aubin Sandio)
2. Interpretation of data and cleansing, limitations to study, conclusion were done by (Dr. Donald Tynes, Dr. Abiodun O. Aboaba and Dr. Shamsa Abdi)
3. Conducting research, interpreting and sampling methods were done by (Dr. Luis Alfonso, Dr. Patrice Delafontaine, Dr. Donald Tynes, Dr. Shamsa Abdi and Dr. Abiodun O. Aboaba).
4. Interpreting results, tables, organization of entire paper and writing abstract, discussions, title and keywords were done by (Dr. Smart Asare).

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