

Blood pressure outcomes to different exercise modes in African Americans: a systematic review

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Abstract

Background

Exercise interventions have been established to help control blood pressure (BP) in African American cardiac patients. The research is limited in comparing the various types, modes, or exercise intensities and examines the most beneficial to lower BP in non-European groups, specifically African Americans.

Objectives

This systematic review aimed to investigate the blood pressure (BP) response to different exercise training modes and workloads in African American adults with or without hypertension (HTN).

Methods

A systematic literature search was carried out with two databases to search for relevant manuscripts related to exercise training.

Results

Nine papers met the inclusion criteria and were analysed. Two of the nine studies did not report a significant difference in BP from baseline to post-exercise. The most common exercise mode was walking at moderate to high intensity, specifically among female participants.

Conclusions

The results supported and are consistent with other research showing that all exercise modes can control and lower BP, but found walking more appealing with African American women.

Introduction

There is a burden of hypertension (HTN) or HTN related conditions (i.e., left ventricular hypertrophy, stroke) among African Americans [1–3]. The research has noted that this group exhibits the highest HTN globally, significantly increasing their cardiovascular risk for the disease [2]. Hypertension also places African Americans at risk for higher morbidity and mortality than other groups in the United States [1, 2, 4]. Another concern is the inactive lifestyle, where far too many African Americans engage less in physical activity or exercise, despite the countless benefits of active living [5]. In addition, the literature observed that African American women experience higher sedentary behaviour than other racial or ethnic groups [5].

Consequently, these disparities significantly compromise their health outcome and overall quality of life. Because of their poor outlook, appropriate measures have been taken to reduce the weight of disease risk and increase physical activity among African Americans in the last ten or twenty years. For example, lifestyle modification interventions (e.g. exercise promotions) to prevent and manage chronic diseases in varied settings are delivered across the United States aimed at this population, with many showing promising outcomes [6].

Few Systematic Reviews have focused primarily on HTN African Americans and blood pressure (BP) outcomes with different exercise training. It is generally unclear which is the most appropriate exercise method to control BP or stimulate a favourable response. The current Systematic Review objective is to provide a narrative and quantify the intervention studies investigating BP response to various exercise training modes and workloads in African American adults with or without HTN.

Methods

Search terms and strategy

The researcher searched two databases to identify relevant studies: MEDLINE and CINAHL. Three keywords were used to develop the search strategy 1) exercise, 2) blood pressure, and 3) African Americans. Some search terms related to exercise included: fitness, training, aerobics, physical activity, walking, cardiovascular training, treadmill, cycling, etc. Blood pressure related terms included hypertension, systolic blood pressure, diastolic blood pressure, left ventricular hypertrophy, endothelial dysfunction, heart disease. Search terms for African Americans included black or Black Americans. Then, using the accessible text terms and a MeSH heading, the author combined them with the keyword. Below are sample searches for each keyword:

S1 TI (exercise) OR AB ("exercise")

S2 exercise/

S3 S1 OR S2

S4 TI ("blood pressure") OR AB ("blood pressure")

S5 hypertension /

S6 S4 OR S5

S7 TI ("African American") OR AB ("African American")

S8 African American /

S9 S7 OR S8

S10 S3 AND S6 AND S9

The final search strategy for MEDLINE is found in appendix A. After completing the search, all manuscripts found were imported into Mendeley and the reference manager. Another search strategy was reviewing and screening each article's references to identify additional eligible studies.

In ensuring the research currency and relevance to the current practice, the search was limited to only include publications from 2000 to 2020. In addition, geographic location was restricted to studies from the United States, given the population reviewed. Finally, the subject's age was also limited to only include adults 19 years of age and older.

Study Selection

The author examined each of the manuscript titles, abstracts, and the full text to determine if they were relevant. The selected reviews articles needed to measure exercised BP. The exercise mode could include outdoor walking with a pedometer device, treadmill walking/jogging, cycling or stationary cycling, weight training, aerobic exercise, or low to high workload. The intervention group must also be receiving the exercise intervention for at least a period of treatment. All studies needed to include BP changes following exercise were accepted if the result described and had the intervention's efficacy to reduce BP.

All reviewed manuscripts must be written in English in selected studies. All study designs were recognised and included (e.g., randomised controlled trials, pre/post studies, case studies, or observational studies). Additionally, all participants must be adult African Americans with HTN and ≥ 19 years of age. Baseline BP and exercised BP are collected. Manuscripts were excluded for review if they did not focus on the study criteria mentioned above.

Data Extraction

Abstracted data of interest included BP (systolic blood pressure and diastolic blood pressure) at rest and following the training. If available, subjective baseline characteristics such as age, sex, and health conditions are also abstracted. Each manuscript was thoroughly read to select relevant information (e.g., study design, available details on exercise duration, follow-up, site

intervention, sample size and populations, the outcome of interest, and BP findings). All data extraction information was typed in Microsoft word and saved for reference.

Quality assessment (risk of bias)

The author used the Grading of Recommendations, Assessment, Development and Evaluations (GRADE) evaluation tool to measure each manuscript's quality. The GRADE of five primary components 1) risk of bias, 2) inconsistency, 3) indirectness, 4) imprecision, and 5) publication bias [7]. Overall, the tool appraises methodological flaws, consistency of results, quality of research, and treatments' efficiency in studies grading evidence with a high, moderate, low or very low score [7]. Each of the reviewed study's GRADE ratings is found in Table 1.

Statistical methods/Data synthesis

The data collected in the review were subjects' baseline and exercised BP and are expressed as means and standard deviations (SD). Other collected data include a description of the participants, sample size, the type of study design, modes of exercise training, intervention settings, and delivery length.

Results

The PRISMA flowchart for the literature search is presented in the appendix of this study. In the original database, 279 articles we found, with 265 excluded. The data-based search then identified nine potentially relevant published articles to be reviewed. Moreover, the study design had pre-and post-treatment [12–16] with one pilot study [8]. Two of the reviewed studies used a randomised controlled design [9, 11], with one study using a quasi-experimental method [10]. The intervention settings varied. Thus, four studies were entirely done at university research laboratories [12–13, 15, 16]. Among the nine, two were at a university laboratory, with participants' required to complete the intervention with home workouts [11, 14]. The other three study interventions were strictly home-based [8–10].

The largest sample size was in Babbit et al., 13 (n = 80), while the lowest was in Stephens et al. 2007, (n = 12) [12]. Participants were primarily women in most of the study (total ratio of 22.09) and a sample size ranging from 12 to 75 (mean = 33.7 and SD = 20.23). Table 1 included the male and female ratio for each study. Participants' ages varied from 18 to 75 years old. Most of the participants had HTN, with some experiencing comorbidities such as diabetes and obesity.

All review studies measured participants' SBP and DBP at baseline and the following intervention. Table 1 presents the changes in BP effects with varied exercise modes. Two of the nine reviewed studies did not report significant SBP and DBP changes following exercise but showed a slight improvement [12, 15]. Fearheller et al., 2014, for instance, saw post-assessment SBP at 124.5 ± 16.5 and DBP at 79.0 ± 8.3 , which was a slight decrease from baseline SDB = 123.3 ± 13.7 , and DBP = 78.6 ± 7.3 but was not statistically significant [15]. The most BP improvement was reported in the Banks-Wallace research, from baseline SBP = 142.2 ± 18.9 and DBP = 86.6 ± 12.9 to post-exercise SBP = 123.3 ± 46.8 and DBP 80.3 ± 29.8 after 12 months [8].

The most exercise training mode described was pedometer-based [8–10]. Another study had a combination of resistance training and walking [11]. Participants were advised to take ten thousand or more steps with no walking speed guidance. In two review studies, participants were required to exercise on multiple workout machines (i.e. treadmill walking/jogging, rowing and cycling) [12, 13]. Aerobic training on BP was shown in only two studies [14, 15]. In one study, participants performed ergometer cycling [16]. All studies' work rate or intensity was between low and high (40–100%), with some reporting participants exercising at moderate levels. Exercise intervention ranged from 8 weeks to 24 weeks. One study lasted 12 and 18 months [8].

Overall study quality assessment

The GRADE quality scores vary for each study and are available in Table 1. Two studies were automatically considered moderate quality. Each study was randomly and in randomised trials [9, 11]. Because the sample sizes for each were small, the author decided to allocate a moderate quality rating. The remaining studies were given a low-quality score because of the restricted study design and small sample sizes [8, 10, 12–16].

Discussion

Summary of main results

The current review is the first to explore BP impact on different exercise modalities and intensities among African Americans. The SR sought to identify studies that included BP response to exercise intensity levels. It critically evaluated nine relevant manuscripts and included published studies from 2005 to 2014. In this review, the exercise interventions were favourable to lower BP. Only two of the seven studies saw no significant decrease in BP with the training, but improvements were noted in other areas such as participant's cardiorespiratory fitness and workload capacity [12, 15]. Unfortunately, the Fairheller et al. 2014 [15] research did not specify the exercise training. Therefore, we do not know what type of aerobic exercise was prescribed. Likewise, in Stephens et al. 2007 [12], the exercise treatment was likely insufficient to trigger a response that could lower participants' BP, suggesting the amount and level needed to see significant improvement are not similar. Specific exercise guidelines can be helpful for African American women to produce significant BP improvement. Future studies can explore the optimal level of exercise necessary to obtain good BP change in this population. The specific exercise guidelines may differ across ethnicity, gender and health status as multiple factors come into play [12]. This is particularly with African Americans, who are less likely to engage in physical activity than other populations in the United States. Thus, their exercise experiences require unique physical activity and exercise considerations.

The results are in line with other studies demonstrating the effects of BP to exercise response with various exercise modes [17]. For example, a research exercise duration of 4 to 32 days with a frequency of 3 days a week and 30 to 120 minutes a day was sufficient to lower BP with the intensity of around 50–90% of the subjects' maximal exercise capacity [17]. Interestingly, another study mentioned an association between BP reduction with older participants [19]. Regrettably, the authors did not offer any explanations for the relationship. However, this could be that walking does not take much workload, and the intensity is low to moderate, making it a simple activity for older seniors. Indeed, more updated research can determine the relationship between age and BP control on exercise with hypertensive African Americans to test the hypothesis. Furthermore, the average BP change on the different training modes was – 11 mmHg SBP and – 6 mmHg DBP was noted in other studies [17]. The decline in BP could concern mortality and morbidity in specific groups, in this case, African Americans, simply because they are prone to experiencing HTN.

Compared to other training modes, a pedometer-based intervention was the dominating exercise for women, suggesting that walking exercise training appeals to African American women perhaps because of its simplicity and less intense activity. In some walking reviews, participants were provided with a pedometer to record their daily steps without reaching the suggested daily target of 10,000 steps outlined in physical activity and exercise guidelines [18, 19]. Indeed, walking is a low risk and enjoyable activity to inspire individuals to exercise regularly. After an 8-week walking programme with participants, African Americans breast cancer survivors improved SBP ($P = .002$) and DBP ($P = .001$) [20]. Likewise, one meta-analysis noted reductions of 2% in SBP/DBP to be good following walking [21]. A walking exercise mode allows participants to freely engage in exercise at their workload of choice while improving BP [22, 23]. Perhaps, it could explain why African American women were attracted to pedometer walking. Initiating community walking clubs are one approach that can be encouraged to promote and boost active living among African Americans, particularly women. Future research can look at group exercise prescriptions to evaluate the approach and narrow the gap. Also, updated research with home-based physical activity interventions using pedometer walking and addressing intensity and walking steps with African American women warrants further study.

In the present review, the dropout rate was a significant concern in all the studies, suggesting participants' lack of interest to carry on the intervention. Attrition is often a problem in research as participants drop out of a study for unknown reasons before its completion. Perhaps incentive strategies could help to inspire people to continue in their studies. For example, providing study participants with an honorarium or gift cards could be a solution. Another motivator is providing additional support by allowing a family member or a friend to participate in the exercise training with subjects and not include them in the study. Innovated schemes like these are helpful to increase retention rates with groups less likely to remain in research studies, in this case, African Americans. Additionally, there were no adverse effects reported for all modes of training. This supports and agrees with the exercise research, where very few adverse events are reported in these studies [18].

In addition to the exercise training reducing participants' BP, improvements were seen in their fitness and other health parameters (e.g., blood cholesterol). All the reviews are encouraging, as the physical exercise indicated African Americans' desire to improve their health and well-being. This is where the development of sustainable exercise interventions is necessary for this population. Keep in mind that African Americans also experience a higher prevalence of chronic conditions and low exercise levels. Therefore, a high priority to establish leisure time activities is suggested, in this case, regular exercise. Applications could start and be achieved at the community or public health policy level, targeting inactive racialised and ethnic groups. Public health physical activity campaigns to promote population exercise, for example, could start by increasing the presence of African Americans. Approaches that influence lifelong impact or perhaps even developing specific physical activity recommendations directed at groups like African Americans with chronic illnesses would be welcomed. Of course, this will take some time to evolve. However, future research is necessary to identify the most suitable schemes for prolonged exercise improvement for inactive African Americans, specifically those with cardiovascular conditions.

Quality of the evidence

The review excluded manuscripts that did not meet the inclusion criteria. It also narrowed the search result. Nevertheless, the selected studies provided insightful information on African Americans' exercise behaviour with different training modes. We can better understand some of our findings and hypotheses with future studies, thus helping support exercise recommendations and public policies aimed at this group.

Study Limitations

The review had several limitations that should be taken into consideration. Firstly, searching for relevant manuscripts was limited to publications from 2000 to 2020. The decision to restrict the search date was partly due to the lack of available research on African Americans and exercise. Second, the analysis was limited to finding articles in two databases, preventing the author from using other databases. Using different databases could have provided extra information relating to the topic. Thirdly, all the studies' sample size was small. As such, this may prevent studies not to having sufficient power. The small sample size found in the review also limits external validity. Future research with a larger sample group investigating BP effects on exercise is suggested to achieve better methodological quality. Another limitation was the predominance of women participants, specifically in the walking studies. African American male participants were underrepresented in all the reviewed studies. Therefore, it would be appropriate to study more African American males, specifically with cardiovascular conditions to understand their exercise response to BP and their perception of training and motivation for participation. Finally, four of the nine studies reported administering a physical activity questionnaire [12–14, 16]. The inclusion of culturally relevant designed physical activity questionnaires would be appropriate for African American men and women. Regardless of some study limitations, the systematic review supports previous research and reinforces all exercise modes to lessen BP while improving HTN African Americans' well-being.

Conclusion

Despite some limitations, the current review showed that exercise is beneficial to lower BP irrespective of intensity in seven of the nine studies. The mode of training that offers the most benefits is debatable. Nonetheless, exercise walking appears to be the best modality for African Americans, whereas pedometer walking seems more attractive for women. Similar to other studies, the walking exercise lowered BP and found favourable effects to lower SBP, DBP, or both. Future research with an extensive sample of African American women is proposed to evaluate the success and training preference for walking as a means and mode of exercise.

Declarations

Compliance with Ethical Standards

Conflict of interest - The author declares no conflict of interest.

Ethical Approval - This manuscript does not contain any studies with human participants or animals performed by the author.

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Table 1

Table 1-Study Characteristics

Author, year	Methodology/location	Age (year) and Sample size (n)	Exercise mode/duration intensity	BP outcomes (mmHg)	Key findings	GRADE
1. Babbitt et al. 2013 [13]	<i>Design:</i> pre/post <i>Location:</i> university training facility	<i>Age range:</i> 40 - 75 <i>Sample size:</i> n = 42 men n = 32 women Total =74 Gender ratio = 76.19	<i>Exercise:</i> treadmill walking/jogging, stair, rowing ergometer, arm ergometry, stepping, stationary cycling, elliptical cross-training <i>Duration:</i> 24 weeks <i>Intensity:</i> low at 50-65%	<i>Baseline:</i> SBP 124.2 ± 1.9 DBP 78.7 ± 1.1 <i>Post Exercise:</i> SBP 123.6 ± 2.2 DBP 78.6 ± 1.2	Aerobic exercise training is practical to improve endothelial function, including BP and risk reduction for CVD with African Americans subjects	Low quality
2. Banks-Wallace 2007 [8]	<i>Design:</i> a pilot study with pre/post single <i>Location:</i> home-based	<i>Mean age:</i> 50 <i>Sample size:</i> n = 21 women Total =21	<i>Exercise:</i> walking w/pedometer <i>Duration:</i> 12 and 18 months <i>Intensity:</i> low to moderate	<i>Baseline:</i> SBP 142.2 ± 18.9 DBP 86.6 ± 12.9 <i>Post Exercise 12 month:</i> SBP 123.3 ± 46.8 DBP 80.3 ± 29.8 <i>Post Exercise 18 month:</i> SBP 129.5 ± 17.5 DBP 77.8 ± 9.4	The intervention offers means to promote cardiovascular health among HTN African Americans women	Low quality
3. Bell et al. 2014 [14]	<i>Design:</i> pre/post <i>Location:</i> research laboratory/home-based	<i>Age range:</i> 65 and under <i>Sample size:</i> n = 14 women n = 6 men Total = 20 Gender ratio = 42.85	<i>Exercise:</i> aerobic exercise <i>Duration:</i> 12 weeks <i>Intensity:</i> moderate	SDP/DBP decreased by 12.26 + 0.52 mmHg and 8.41 +.073 compared to baseline SBP/ DBP readings (p=.018)	Physical exercise is beneficial to support BP reduction among African Americans diagnosed with HTN	Low quality

4. Bond et al. 2005 [16]	<i>Design:</i> pre/post <i>Location:</i> research laboratory	<i>Age range:</i> 19-26 <i>Sample size:</i> n = 36 women Total = 36	<i>Exercise:</i> ergometer cycling <i>Duration:</i> eight weeks <i>Intensity:</i> moderate at 70%	<i>Baseline:</i> SBP 116 ± 3.5 DBP 73.2 ± 2.0 <i>Post Exercise:</i> SBP 115. ±3.3 DBP 74.1 ± 2.7	Regular aerobic physical activity could reduce SBP/MAP and the risk of HTN young-adult, African-American women	Low quality
5. Feairheller et al. 2014 [15]	<i>Design:</i> single pre/post <i>Location:</i> university laboratory	<i>Age range:</i> 40–75 <i>Sample size:</i> n = 21 n = 5 men Total = 26 Gender ratio = 23.80	<i>Exercise:</i> aerobic exercise <i>Duration:</i> 6 months <i>Intensity:</i> low at 50%-65%	<i>Baseline:</i> SBP 123.3 ± 13.7 DBP 78.6 ± 7.3 <i>Post Exercise:</i> SBP 124.5 ± 16.5 DBP 79.0 ± 8.3	Even with no significant improvement in BP, aerobic exercise training can lower BP with African Americans subject	Low quality
6. Hornbuckle et al. 2012 [11]	<i>Design:</i> A randomised trial (two treatment groups) <i>Location:</i> university training facility and home-based	<i>Age range:</i> 39- 61 <i>Sample size:</i> n = 44 women Total = 44	<i>Exercise:</i> walking/ resistance training <i>Duration:</i> 12- weeks <i>Intensity:</i> low to moderate	<i>W- Baseline:</i> SBP 126 ± 12 DBP 84 ± 9 <i>WRT- Baseline:</i> SBP 130 ± 16 DBP 87 ± 10 <i>W- Post Exercise:</i> SBP 127 ± 15 DBP 85 ± 10 <i>WRT- Post Exercise:</i> SBP 131 ± 22 DBP 81 ± 10	Walking with resistance training was suitable for improving body composition, including BP, rather than just walking alone.	Moderate quality
7. Stephens et al. 2007 [12]	<i>Design:</i> pre/post <i>Location:</i> university training facility	<i>Age range:</i> 30-45 <i>Sample size:</i> n = 12 women Total =12	<i>Exercise:</i> treadmill walking and cycling <i>Duration:</i> 10 weeks <i>Intensity:</i> moderate/high at 70% -85%	<i>Baseline:</i> SBP 127 ± 3 DBP 83 ± 1 <i>Post Exercise:</i> SBP 122 ± 3 DBP 82 ± 2	There was no significant difference in SBP/DBP/MAP before or after exercise	Low quality
8. Sohn, et	<i>Design:</i> randomised	<i>Age</i>	<i>Exercise:</i>	<i>I -Baseline:</i>	Walking an	Moderate

al. 2007 [9]	controlled <i>Location:</i> home-based	<i>range:</i> 32-54 <i>Sample size:</i> n= 12 women n= 6 men Total = 18 Gender ratio = 200	walking w/pedometer <i>Duration:</i> 26 weeks <i>Intensity:</i> moderate	SBP 147.7 ± 4.5 DBP 95.7 ± 3.2 <i>C-Baseline:</i> SBP 146.2 ± 4.0 DBP 94.8 ± 2.3 <i>I-Post Exercise:</i> SBP 134.4 ± 3.4 DBP 88.6 ± 2.6 <i>C- Post Exercise:</i> SBP 142.8 ± 3.0 DBP 93.9 ± 2.9	extra 30 minutes a day was linked with lower SBP/DBP/MAP	quality
9. Zoellner et al. 2010 [10]	<i>Design:</i> Quasi-experimental <i>Location:</i> home-based	<i>Age range:</i> 18-35 <i>Sample size:</i> n = 75 women Total =75	<i>Exercise:</i> walking w/pedometer <i>Duration:</i> 23 weeks <i>Intensity:</i> moderate	SBP -09 (p-value 0.27) DBP -21 (p-value 0.06)	The outcomes were positive to increase steps/per day, thus reducing BP	Low quality
<p>systolic blood pressure = SBP, diastolic blood pressure =DBP, mean arterial pressure=MAP, I=intervention, C=control, walking = W</p> <p>walking/ resistance training = WRT</p>						

Supplementary Files

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