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Effects of aerobic dance on systolic blood pressure in stage one hypertensive adults in Uganda

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ABSTRACT

Objective To investigate the effects of a 12-week aerobic dance programme on systolic blood pressure (SBP) in stage one hypertensive adults.

Methods This study employed an experimental research design. 36 out of 58 stage one hypertensive adults randomly assigned into experimental and control groups completed the programme. SBP was measured using a mercury sphygmomanometer at baseline and post programme. The experimental group participants trained thrice a week, 45 min per session, and at a moderate intensity, but the control group continued doing their daily routines. Data were analysed using SPSS V.20. A two-tailed t-test was used to compare the mean differences of the two groups. A p value of <0.05 was considered statistically significant.

Results The experimental group had a mean SBP of 143.83±6.382 mm Hg at baseline, while the control had 137.61±6.400 mm Hg. After a 12-week aerobic dance programme, the mean SBP of the experimental group reduced to 136.33±9.191 mm Hg, while that of the control group increased to 139.56±9.954 mm Hg. This implies that the 12-week aerobic dance programme reduced the SBP of the experimental group by −7.50 mm Hg while that of the control group remained more or less the same by having a marginal increment of 1.50 mm Hg. The changes were statistically significant (p<0.002) after a 12-week aerobic dance programme.

Conclusion The aerobic dance programme effectively manages the SBP of stage one hypertensive adults. In Uganda, stakeholders and policymakers should consider incorporating aerobic dance as a non-pharmacological method for hypertension management protocols.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Aerobic exercises have proven to improve hypertension. However, little is known about the effects of aerobic dance in stage one hypertensive adults.

WHAT THIS STUDY ADDS

⇒ Aerobic dance programmes designed using traditional Ugandan music are mostly effective for exercise interventions in a Ugandan context. This study incorporated familiar cultural melodies which increased pleasure, enjoyment and social connection, eventually promoting adherence among stage one hypertensive adults. The use of local music in this study fostered a sense of cultural identity, which made the aerobic dance programme more engaging and sustainable for the study participants.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ This study provides scientific knowledge to guide stakeholders and policymakers in incorporating aerobic dance programmes into hypertension management protocols. This could reduce reliance on medication, thus improving overall health outcomes. Additionally, this study highlights the potential of traditional music as a culturally relevant strategy to promote physical activity and combat hypertension in Uganda. Policy makers in Uganda may use the findings from this study to inform Ugandans on the development of innovative health and wellness programmes, incorporating traditional music into exercise programmes that may encourage increased community engagement and participation in physical activity, promote cultural preservation and appreciation, and foster the culture of wellness and health promotion among Ugandans.

INTRODUCTION

Hypertension is among the most significant global concerns, affecting over 1.5 billion people worldwide.[1] It almost accounts for over 10.8 million deaths yearly[2] and has significantly increased the worldwide burden of disease and premature deaths. Furthermore, it poses a significant risk for cardiovascular illnesses, which are the world's leading causes of death.[3] Additionally, peripheral artery disease, stroke, kidney disease and eye issues are all made worse by hypertension.[4] Beyond just health, hypertension (defined as systolic blood pressure (SBP) ≥140 mm Hg and diastolic blood pressure (DBP) ≥90 mm Hg) has major financial ramifications for individuals, families, communities and healthcare systems.[4 5] Hypertension-related treatment, long-term care and lost productivity come at a high cost that can obstruct societal and economic progress.[6] Several factors contribute to the development of

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hypertension, including genetics, age, certain medical conditions, medications, socioeconomic factors, urbanisation, poor diet, sedentary lifestyle, obesity, tobacco use, excessive alcohol consumption, stress, and lack of awareness and screening.[7 8]

Africa has one of the highest rates of hypertension worldwide,[9 10] with an adult incidence of over 46%. However, the lack of reasonably priced medications, poor healthcare infrastructure, a scarcity of qualified medical personnel, unequal access to healthcare services, especially in rural areas, and general poverty make it difficult for many African nations, including Uganda, to effectively treat hypertension.[11 12]

Currently, hypertension is a significant health concern for Uganda, with an estimated prevalence between 26.5%[13] and 31.5%[14] among adults aged 18 years and older.[15] In 2015, hypertension was among the major mortality hazard factors in Uganda, accounting for 20% of deaths of adults above 18 years.[5] Poor management of hypertension due to lifestyle factors and lack of knowledge significantly contribute to the rise of hypertension in Uganda.[15 16] Additionally, compared with urban areas, the availability and cost of hypertension medicine in Uganda's rural health facilities and private pharmacies are restricted.[17 18] Many Ugandans, including the government, families and individuals, are financially impacted by hypertension because of the significant costs involved in diagnosis, treatment and maintenance.[19] Sometimes, shortages of prescription drugs worsen hypertension, which most Ugandans cannot afford to control at all.[20] Because of its high incidence and related costs, it is, therefore, imperative to explore alternative approaches to managing hypertension. Lifestyle modifications, such as exercise, provide several physiological benefits, making them a viable non-pharmacological method of controlling hypertension.[21]

It has been demonstrated that regular exercise reduces sympathetic tone due to decreased nervous system activation and decreases renin activity, leading to vasodilation, lowering blood pressure (BP)[22–24] and improving overall cardiovascular health. It increases vasodilation through endothelial nitric oxide synthase activity, increasing nitric oxide.[24] Since there is limited research and interventions on the effects of aerobic dance for people with stage one hypertension in African countries, particularly in Uganda, this study investigated the reducing effect of a 12-week aerobic dance programme on SBP of stage one hypertensive individuals. The study hypothesised that there would be no statistically significant difference in SBP levels among stage one hypertensive adults in Kampala, Uganda, after a 12-week aerobic dance programme.

MATERIALS AND METHODS

Study design

The study employed an experimental research design (figure 1). The aerobic dance programme was controlled, and its effects on SBP after the 12 weeks were observed. The 58 participants were randomly assigned to experimental or control groups using opaque envelopes labelled from 1 to 58. The 29 experimental group and 29 control group assignment slips were written. Each was placed in a properly sealed envelope to ensure concealment, and the envelopes were shuffled manually to ensure randomness. Each participant in the study selected an envelope that revealed the group that was allocated to them. Research assistants randomised the process. Data were collected from stage one hypertensive adults attending Kyambogo University Medical Centre in Kampala, Uganda. All participants signed the consent form after being given thorough information about the study. The experimental group participants were engaged in aerobic dance that maintained a moderate intensity. In contrast, the control group participants did not participate in any organised physical activity and maintained regular habits. The consort reporting guidelines were used in this study.[25]

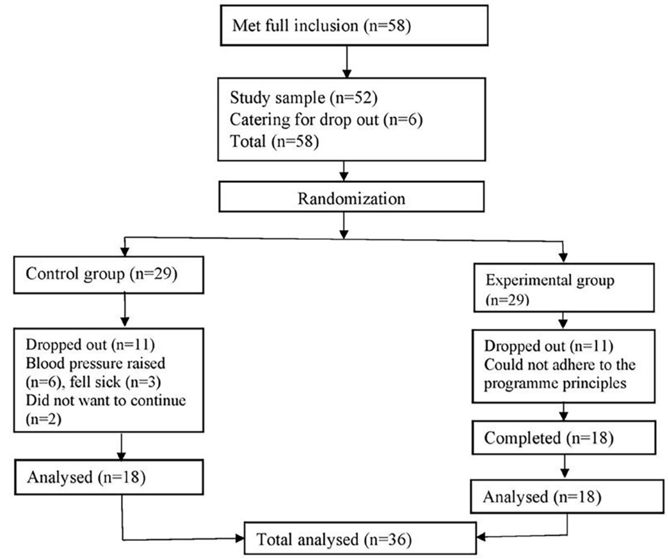

Figure 1 Flow diagram of the study sample. n, number of participants.

Sample size determination

The sample size was determined before the study was conducted using the G*power programme (V.3.1.9.4). The input parameters were two tails, an effect size of 0.8, an error probability of 0.05 and a power of 80%. A two-group t-test was selected as a statistical test to compare the difference between two independent means. The suggested sample size for each group was 26 participants, resulting in 52 participants. Six more participants were added to cater to any dropouts, although ultimately, 22 participants dropped out, leaving 36 who completed the study. The power of 80% was used as it is accepted in most experimental studies.[26]

Participants' recruitment

The study assessed eligibility and exclusion criteria for adults with stage one hypertension. It included participants who fulfilled the following requirements: (a) stage one hypertension; (b) male and female; (c) age range of

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30 to 59 years; and (d) no history of organised physical activity over the preceding 6 months. Those who were not in the range of stage one hypertension, were pregnant, were physically incapable of exercising, had a history of stroke, heart failure, liver disease, type 2 diabetes or other serious medical conditions, were taking antihypertensive medication, regularly smoked, drank alcohol, or took dietary supplements were excluded from the study.

Blood pressure measurements

Both the experimental and control groups' participants' baseline and post-programme SBP were measured using a mercury sphygmomanometer (Fizzini S.R.L., Padana sup.317,20090, G3M 110944963023, Vimodrone, Italy). The measurements were finished in a dedicated space meant for data collection. The participants rested for 5 min before having their left arm's BP measured. During the measurement, participants sat up straight in a chair with their backs straight, arms supported at heart level, feet flat on the floor, legs uncrossed, and no talking or movement allowed. The mean of the three averaged measurements, which were taken with a 2 min gap between each reading, was used for analysis in this study.

Aerobic dance programme

The participants in the experimental group participated in an aerobic dance programme which lasted for 12 weeks, 3 days a week, 45 min per session at a moderate intensity (40–60% of maximum heart rate), which was considered safe for the participants[27] and monitored by Garmin heart rate monitor. The heart rate monitor had a Bluetooth sensor to connect to the squad heart rate software to ensure participants maintained safety zones throughout the training. The participants performed all five aerobic dance phases: warm-up, aerobic phase, standing cool down, muscle strengthening and flexibility/relaxation phases. During the aerobic dance sessions, the primary researcher performed the central monitoring of participants to ensure that they maintained safe zones, while the research assistants (fitness instructors) perfomed the sessions and guided participants to perform the right movements. The participants in the control group maintained their usual activities during the study period. A professional nurse monitored the study participants weekly to ensure their general health status did not significantly change during the study period. The aerobic dance programme was performed thrice a week (frequency), with sessions lasting 45 min, all consisting of moderate-intensity aerobic dance (type).

Statistical analysis

Data was analysed using the Statistical Package for Social Sciences V.20. A paired-sample t-test analysis was used to compare the mean differences of the two groups from baseline to post-test. The p value<0.05 was considered statistically significant.

RESULTS

Table 1 displays the participants' demographic data, including participant type, age group, gender, marital status and education level. Male and female participants of the experimental group comprised 50% each, whereas 66.7% male and 33.3% female were in the control group. In the experimental group, the percentage of participants aged 30–39 and 40–49 was equal (44.4%). Participants in the control group who were 50–59 years old made up the majority (38.9%).

Descriptive results on systolic blood pressure in stage one hypertensive adults

The graphs showing the pre-test and post-test readings of the SBP are shown in figure 2. The y-axis does not start from zero.

The graphs show a marked decline in the SBP of the experimental group and a marginal increase in the control group. The results imply that by controlling for the marginal increment seen in the control group, the resultant effect of the experimental group will still be a drop in the SBP. To clarify the differences, descriptive analysis was conducted, and the results are presented in table 2.

Table 2 shows that at baseline and post-programme, the mean SBP of the experimental group was 143.83±6.38 mm Hg and 136.33±9.19 mm Hg, respectively. According to the descriptive results, the experimental group's SBP generally decreased by −7.50 mm Hg between the pre-test and post-test readings. Conversely, the mean values of the control group at baseline and post-programme were 137.61±6.40 mm Hg and 139.56±9.95 mm Hg, respectively. This showed that after 12 weeks, the control group's SBP had increased by +1.95 mm Hg. The change in the control group was minimal, suggesting that aerobic dance was responsible for the differences between these two groups.

Table 3 breaks down the results by gender and shows that there were significant changes in the experimental group for both males and females (−6.00±5.59 mm Hg and −9.00±10.81 mm Hg, respectively) but very little change in the control group (+2.33±9.66 mm Hg males and +1.17±3.13 mm Hg females). Additionally, in the experimental group, the females experienced a greater decline in SBP (−9.00 mm Hg) than males (−6.00 mm Hg), suggesting that aerobic dance benefits women more than men. While the control group's results were insignificant, the study established a slightly larger increase in the SBP of the males compared with the female participants. Since the group did not participate in the aerobic dance, this difference can only be explained by other factors.

Paired-sample t-test analysis for SBP in stage one hypertensive adults

Table 4 presents the findings of the paired-sample t-test that was performed. There was a significant difference as the p value of 0.002 is less than the set p value of 0.05.

Table 4 shows that the t-test of the experimental group was established to be statistically significant as the p value of 0.002 is less than 0.05. The results are as follows: t (17) = 3.75, p<0.05. In the t-test, the control group was

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Table 1 Demographic information of the study participants

Variables	Parameters	Experimental group		Control group	
		Frequency (n)	Per cent (%)	Frequency (n)	Per cent (%)
Gender	Male	9	50.0	12	66.7
	Female	9	50.0	6	33.3
	Total	18	100.0	18	100.0
Age group (years)	30–39	8	44.4	5	27.8
	40–49	8	44.4	6	33.3
	50–50	2	11.1	7	38.9
	Total	18	100.0	18	100.0
Marital status	Married	12	66.7	18	100.0
	Single	5	27.8	0	0
	Divorced	1	5.6	0	0
	Total	18	100.0	18	100.0
Participant type	Staff	14	77.8	10	55.6
	Student	3	16.7	8	44.4
	Community member	1	5.6	0	0.0
	Total	18	100.0	18	100.0
Education level	Secondary	1	5.6	1	5.6
	Diploma	3	16.7	7	38.9
	Bachelor	9	50.0	4	22.2
	Masters	3	16.7	5	27.8
	PhD	2	11.1	1	5.6
	Total	18	100.0	18	100.0

%, percent; n, frequency; PhD, Doctor of Philosophy.

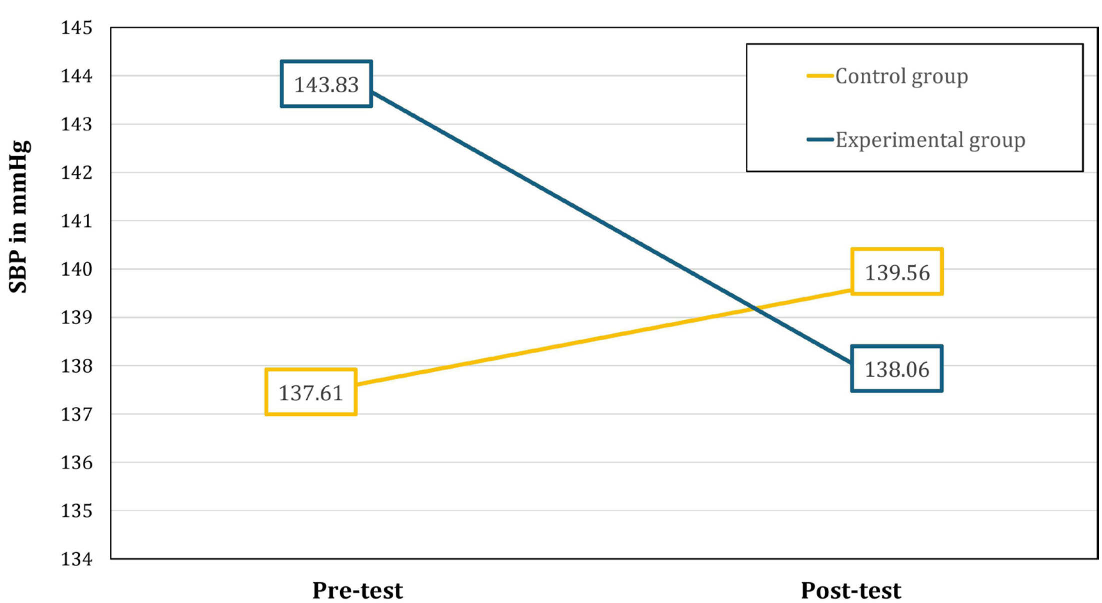

Figure 2 SBP comparison between experimental and control groups. Data were collected at baseline (pre-test) and after the programme (post-test). The experimental group graph (blue) shows a marked decrease in SBP between pre-test and post-test. The control group graph (orange) shows a marginal increase in SBP between pre-test and post-test. mm Hg, millimetres of mercury; SBP, systolic blood pressure.

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Table 2 Changes in SBP

Groups	Parameters	Pre-test SBP	Post-test SBP	Change in SBP
Experimental group	Number	18	18	18
	Mean	143.83	136.33	−7.50 mm Hg
	SD	6.38	9.19	8.49
Control group	Number	18	18	18
	Mean	137.61	139.56	+1.95 mm Hg
	SD	6.40	9.95	7.97

mm Hg, millimetres of mercury; SBP, systolic blood pressure.

not statistically significant as the results were as follows: t (17) = −1.04, p=0.315, which is >0.05. Considering that the p value of the experimental group, in this case, was 0.002, which was less than the alpha level (0.05) since a 95% level of significance was considered in this test, the hypothesis that there would be no significant difference in SBP levels of stage one hypothesis adults was rejected. This implies that the aerobic dance programme statistically significantly reduced the SBP of adults with stage one hypertension.

According to the p values, it is observed that the changes in SBP for both the male and female participants in the experimental group were statistically significant, with the former having a p value of 0.01 and the latter 0.04 (table 5). This implies that the changes were significant at 95% level of significance. On the other hand, the changes in the SBP of the control group's male and female participants were statistically insignificant at p values of 0.42 and 0.40, respectively. These results show that the 12-week aerobic dance statistically significantly lowered the SBP of male and female stage one hypertensive adults.

DISCUSSIONS

The study investigated whether an aerobic dance programme reduced the SBP of stage one hypertensive adults. The study found that after a 12-week aerobic dance programme, the experimental group's SBP significantly dropped. The outcomes also demonstrated that the control group's SBP barely changed after the 12 weeks, remaining rather constant. The SBP of the male and female experimental group participants revealed significant changes in this study. However, the female group's SBP dropped more than the male group's. Furthermore, it was demonstrated that after a 12-week aerobic dance programme, the male control group participants' SBP slightly rose compared with the female participants' SBP.

According to the study's findings, after a 12-week aerobic dance programme, the experimental group's subjects' SBP considerably decreased. Similar to the current study's findings, other research (Maruf *et al*[28] and Kazeminia *et al*)[29] also found that aerobic exercise interventions significantly lowered the experimental group's SBP. Researchers Gunjal *et al*[30] examined how aerobic interval training affected hypertensive patients'

Table 3 Changes in SBP disaggregated by gender

Groups	Parameters		Post-test SBP	Pre-test SBP	Change in SBP
Experimental group	Male	Number	9	9	
		Mean	137.00	143.00	−6.00 mm Hg
		SD	5.45	7.78	5.590
	Female	Number	9	9	
		Mean	135.67	144.67	−9.00 mm Hg
		SD	12.20	4.95	10.81
Control group	Male	Number	12	12	
		Mean	140.08	137.75	+2.33 mm Hg
		SD	11.45	6.28	9.66
		Number	6	6	
	Female	Mean	138.50	137.33	+1.17 mm Hg
		SD	6.80	7.23	3.13

mm Hg, millimetres of mercury; SBP, systolic blood pressure.

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Table 4 Paired-sample results for pre-test–post-test comparison of SBP

		Paired differences			95% CI				
Groups		Mean	SD	SEM	Lower	Upper	t	df	P value
Experimental group	Pre-test–post-test SBP	−7.50	8.49	2.00	3.28	11.72	3.75	17	0.002
Control group	Pre-test–post-test SBP	1.95	7.97	1.88	−5.91	2.02	−1.04	17	0.315

df, degrees of freedom; P value, probability value (significance level); SBP, systolic blood pressure; t, T-statistic.

BP. After a 12-week intervention, their findings indicated a significant drop in SBP. Similarly, Daimo *et al*[31] looked into how males with hypertension's BP were affected by aerobic exercise. They discovered that aerobic exercise significantly lowered SBP. The present study's outcomes align with those of Navan,[32] who examined the impact of aerobic exercise on cardiovascular risk-taking factors in 20 hypertensive males over 8 weeks, with three sessions per week lasting 45 min each. His results showed that the intervention group's SBP had significantly decreased.

The current study's findings are consistent with systematic reviews' and meta-analyses' findings that aerobic exercise considerably lowers BP.[32 33] In their study, Gunjah *et al*[30] examined how aerobic exercise affected older persons' BP. Aerobic exercise was found to considerably lower SBP. In their investigation of the effects of dance therapy on BP in people with hypertension, Conceicao *et al*[33] came to the same conclusions. They discovered that the therapy group's SBP had significantly decreased. Zhu *et al*[34] made a similar discovery while examining how exercise affected patients' BP. They discovered a noteworthy drop in the SBP. Since the experimental group showed a significant decrease in SBP, the highlighted studies support the findings of the current investigation. Organised moderate-intensity aerobic workouts were used in all of these investigations. Aerobic exercise improves endothelial function, which facilitates blood vessel dilatation[31 34 35] and reduces arterial stiffness[35 36] by increasing pulse wave velocity,[37] both of which lower BP. This may also account for the reduction in SBP observed in these studies. Thus, it is evident from the study's findings that exercise is crucial for managing and preventing hypertension. Exercise scientists can now contribute to the management of people predisposed to hypertension and support clinicians in prescribing exercises for hypertensive patients. This will elicit scientists to conduct further studies about the area.

The current study's substantial SBP reduction in stage one hypertensive adults has great clinical significance. Reduced BP is said to lower the risk of cardiovascular illnesses. Ettehad *et al*[38] examined the effect of reducing BP on avoiding cardiovascular disease and death. They discovered that all causes of death and major cardiovascular events are reduced by 13% by a considerable decrease of 10 mm Hg in SBP. This means that the current study, which lowered SBP by 7.50 mm Hg, may also have decreased cardiovascular disease and overall mortality risk by 9.75%. In another meta-analysis, Canoy *et al*[39] looked at lowering BP as a preventative measure for cardiovascular illnesses. They discovered that a 5 mm Hg drop in SBP reduced the probability of experiencing cardiovascular events by 10%. According to this study, an aerobic dance programme can lower BP by 7.50 mm Hg, which may reduce participants' risk of cardiovascular disease by 15%. These clinically meaningful findings suggest that individuals in the experimental group had lower SBP and a lower chance of acquiring additional cardiovascular illnesses.

The results of this study contradict those of Lima and colleagues, who examined the impact of aerobic training on BP in women who were not menopausal for 12 weeks, five times a week, for 60 min each session, and at an intensity ranging from 60% to 70% of heart rate reserve.[40] Their research concluded that aerobic training was not capable of altering BP. It was determined that aerobic exercise does not influence pre-menopausal and post-menopausal women's SBP alterations. Comparably, Arsenault and associates similarly studied how exercise training affected cardiometabolic risk indicators in overweight/obese post-menopausal women with increased BP

Table 5 Paired-sample test results for pre-test–post-test comparison of SBP disaggregated by gender

			Paired differences			95% CI				
Group	Gender		Mean	SD	SEM	Lower	Upper	t	df	P value
Experimental group	Male	Post-test SBP–pre-test SBP	−6.00	5.59	1.86	1.70	10.30	3.22	8	0.01
	Female	Post-test SBP–pre-test SBP	−9.00	10.81	3.60	0.69	17.31	2.50	8	0.04
Control group	Male	Post-test SBP–pre-test SBP	+2.33	9.66	2.79	−8.47	3.81	−0.84	11	0.42
	Female	Post-test SBP–pre-test SBP	+1.17	3.13	1.28	−4.45	2.11	−0.91	5	0.40

df, degrees of freedom; P value, probability value (significance level); SBP, systolic blood pressure; t, T-statistic.

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who were sedentary but otherwise metabolically healthy.[41] Six months of training, three to four times a week at 50% of maximal oxygen intake, was required for this investigation. This investigation discovered a negligible drop in SBP, which contrasts with those reported in this research, which discovered a substantial drop in SBP following a 12-week aerobic dance programme. Since most trials with a drop in SBP employed aerobic exercises regulated by music at varying tempos, this may be due to inconsistent management of the intensity of aerobic activity.

Exercise-related research is scarce, especially in sub-Saharan Africa. To improve the outcomes of the SBP, further study on aerobic dance and other lifestyle modification strategies, such as nutrition counselling, should be conducted. One of the risk factors for hypertension is obesity, and poor nutrition is well known to be a major contributor to obesity. Lowering the SBP to normal values and avoiding other non-communicable diseases may be possible by combining nutritional counselling with aerobic dance.

Strength and limitations

This study is the first for the Ugandan population and provides important information supporting future studies. The reduced sample size due to high dropout led to a leaner sample size, although it was still statistically sufficient to make inferences from the results. The short intervention and lack of longitudinal follow-up might be additional factors limiting the drawing of conclusions from the findings.

Clinical implications

The findings from this study show that aerobic dance can help lower SBP. This advocates that aerobic dance at a moderate intensity should be included in the clinical practice guidelines for managing and preventing hypertension. This could increase the options for the first line of treatment for hypertension for both patients and the healthcare system. Globally, hypertension management and treatment involve high costs,[42] and many options have been available, but others are under investigation to improve BP and reduce the financial burden of treatment.[43] Since aerobic dance is convenient and cheaper and requires minimal equipment, it may support this effort to reduce the burden of hypertension.

CONCLUSIONS

This study found a statistically significant reduction in the SBP of the experimental group after a 12-week moderate-intensity aerobic dance programme. This study concluded that a 12-week aerobic dance programme is an effective non-pharmacological method for reducing SBP in stage one hypertensive individuals. The study suggested that further larger studies comparing other forms of physical activities and similar different cultural setups will be worthwhile consideration for further studies.

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Contributors LN (guarantor), conceptualised the study, designed the methods, collected the data, drafted the original manuscript, reviewed and edited the manuscript. L-JW, EKB and CANN supervised, revised the methods, approved, reviewed and edited the manuscript's content and MM performed statistical analysis.

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Competing interests None declared.

Patient and public involvement Patients and the public were not involved in designing, conducting the study and planning to disseminate the results.

Patient consent for publication Not applicable.

Ethics approval The Uganda National Council for Science and Technology (reg. No: HS2202ES) and the Gulu Research Ethics Committee (LHIREC NO: 0196/12/2021) of St. Mary's Hospital Lacor approved this study. All participants provided written consent after being fully informed about the study's protocols and confidentiality.

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Data availability statement Data are available upon reasonable request. Data are available from the corresponding author on reasonable request.

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