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RESEARCH ARTICLE

Cardiovascular Response to Manual Acupuncture Needle Stimulation among Apparently Healthy Nigerian Adults

Ganiyu Sokunbi [1,*], Stanley Maduagwu [2], Olabode Jaiyeola [2], Hassan Gambo [2], Cephas Blasu [2]

[1] *Physiotherapy Department, Faculty of Allied Health Sciences, Bayero University, Kano, Nigeria*
[2] *Department of Physiotherapy, University of Maiduguri Teaching Hospital, Borno-State, Nigeria*

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Abstract
This study investigated experience with acupuncture needle stimulation of apparently healthy adult Nigerians and the responses of the systolic blood pressure (SBP), diastolic blood pressure, heart rate (HR), and rate pressure products (RPP) to acupuncture at both real acupuncture points relevant to the treatment of cardiovascular disorder and sham acupuncture points not relevant to the treatment of cardiovascular disorder. Seventy-eight participants were randomly placed into three groups: the real acupuncture group (RAG); the sham acupuncture group (SAG); and the control group, with 26 participants per group. Data were collected preintervention, 15 minutes into acupuncture stimulation, postintervention, and 15 minutes after intervention. Changes (postintervention − preintervention scores) in the SBP, HR, and RPP were statistically lower in the RAG than in the SAG. Changes in the DBP showed a significant difference between the SAG and the RAG ($p > 0.05$). Findings from this study showed that among apparently healthy Nigerian adults, acupuncture needle stimulation at acupoints relevant to cardiovascular disorders

* Corresponding author. Physiotherapy Department, Faculty of Allied Health Sciences, Bayero University, PMB 3011 Kano, Kano-State, Nigeria.
E-mail: ganiyusokunbi@gmail.com (G. Sokunbi).

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was more effective than sham intervention in reducing the SBP, HR, and RPP. Participants reported heaviness, numbness, and increasing pain, but no dizziness, fainting and/or life-threatening side effects, during and after the acupuncture needle stimulation.

1. Introduction

Scientific advances in acupuncture research, coupled with the side effects of treating certain medical conditions by using conventional drugs, have promoted public interest in and demands for acupuncture dramatically in recent times [1—3]. Over 90% of physicians are estimated to have used acupuncture in German pain clinics and, in the USA, over 11,000 physicians have an interest in acupuncture [1]. Moreover, in the UK, veterinarians, nurses, chiropractors, physiotherapists, and naturopaths use acupuncture even more than physicians [1]. Acupuncture and shiatsu massage accounted for 61% of all treatments provided in a clinic in a study conducted among patients treated in the Clait Health Services in Israel. However, data on public interest, patterns of use, and effects and side effects of acupuncture treatment among Nigerians and sub-Saharan Africans are limited.

The most common reason patients seek acupuncture treatment is a musculoskeletal condition [4]. Recently, a few studies from Africa in which the efficacy of acupuncture in the management of gynecological condition, work-related musculoskeletal disorders, postsurgical spinal rehabilitation, and ergonomic intervention have been reported [5—9]. However, the effects of acupuncture treatment are not limited to pain reduction in neuromusculoskeletal conditions alone; they are widespread and involve the cardiovascular, as well as other, systems. Published studies on laboratory animals and humans have reported that acupuncture has a beneficial effect on cardiovascular parameters such as the blood pressure [10—13]. Studies on the cardiovascular responses to acupuncture among Nigerians and people of the black African race are scarce, and the results of studies from other parts of the world demonstrating the effects of acupuncture treatment of cardiovascular diseases are not consistent.

As early as the 1950s, results from many clinical studies suggested that acupuncture had an effect on the cardiovascular parameters in patients with essential hypertension [14,15]. In 1975, acupuncture was found to significantly reduce the systolic blood pressure (SBP) and the diastolic blood pressure (DBP) in 24 of 28 patients with essential hypertension, but the conclusions drawn were not credible because all of the studies were either observational or case reports, with small sample sizes, unrigorous designs, and control group interventions that were medications or other blood pressure lowering therapies [15]. Taken as a whole, the current evidence is not good enough to make unequivocal claims as regards to both the cardiovascular responses to acupuncture and the efficacy of acupuncture for treating cardiovascular disease among Nigerians and people of the black African race. Ethnic differences in responses to pharmacological agents capable of altering cardiovascular parameters have been reported [16,17]. Thus, the cardiovascular response to acupuncture treatment might vary from one ethnic group to another. In addition, many healthcare professionals in Nigeria are reluctant to recommend acupuncture because its effects on cardiovascular parameters remain controversial and because the physiological mechanisms determining its actions among people of the black African race are largely unknown. Thus, the present study is a preliminary study carried out to answer the following questions: What would be the experience of participants undergoing acupuncture needle stimulation? Would selected cardiovascular parameters among adult Nigerians who received acupuncture needle stimulation at acupoints relevant to the treatment of cardiovascular disorders (real acupuncture) be different from those among adult Nigerians who received acupuncture needle stimulation at acupoints not relevant to the treatment of cardiovascular disorders (sham acupuncture) and from those among adult Nigerians in the control group (no acupuncture needle stimulation)? Would real acupuncture and sham acupuncture stimulation affect the changes in the selected cardiovascular parameters differently? The outcome of this preliminary study will add to existing information on the impact of acupuncture on selected cardiovascular parameters in apparently healthy adults, especially apparently healthy adults of black African origin. It will also be useful in designing a future, large, randomized, controlled trial in which the effects of acupuncture treatment on blood pressure among Nigerians with hypertension will be investigated.

2. Materials and methods

This research was designed as a randomized, controlled trial in which all conditions were the same for both the experimental and the control groups, with the exception that the experimental groups received either real acupuncture or sham acupuncture needle stimulation and the control group received no needle stimulation. This study included 78 participants, with 26 participants in each of the three groups, two experimental groups, and one control group. This sample size was adopted from a similar study carried out by Cené et al [18].

Approval to carry out this study was obtained from the Research and Ethics Committee of the University of Maiduguri Teaching Hospital, Maiduguri, Nigeria. Detailed information on what the study was about, its potential benefits and possible side effects, and what would be expected of the participants during the study was provided on a participant information sheet, which was made available to the participants prior to the intervention. Participants were required to sign a written informed consent, and they were given enough time to consult with their doctors to decide if they would be suitable for this trial.

Apparently healthy volunteers from among the staff and the students of the University of Maiduguri and the University of Maiduguri Teaching Hospital (UMTH) participated in this study. Recruitment posters and handbills were distributed to prospective participants in the outpatient clinics of UMTH. Recruitment posters were also displayed on notice boards at strategic areas within UMTH.

Participants who were aged ≥ 18 years, were without any cardiovascular and/or neuromusculoskeletal conditions that could be affected by the study, and were willing to comply with the study protocol were included in the study. Any participant who had had a previous experience with acupuncture treatment was excluded. Finally, 78 participants were selected for inclusion in this study. A computer-generated randomization schedule was created to assign the participants into one of three groups: the real acupuncture group (RAG); the sham acupuncture group (SAG); and the control group (CG). All participants were informed that they might be randomly allocated to any of the three groups. This procedure was carried out to ensure that each eligible participant had equal probability of being assigned to any one of the three groups.

A flow chart for this study is presented in Fig. 1. Participants were asked their ages in years to the nearest birthday. Body weights were measured using a Hanson model portable bathroom weighing scale with the participants standing erect and feet slightly apart on the weighing scale. Weights were recorded to the nearest 0.1 kg. Heights were measured by using a standiometer with the participant standing on a flat surface with heels, buttocks and the shoulders touching the vertical surface to which the standiometer was fixed, and the measurement was completed by bringing a ruler placed on the vertex flush to the vertical surface. Heights were recorded to the nearest 0.1 m.

For the assessment of the preintervention outcomes, participants were asked to refrain from smoking cigarettes and/or taking coffee for at least 30 minutes prior to coming in for the study as these might affect the SBP, the DBP, and the heart rate (HR) measurements [19]. SBP, DBP, and HR measurements were carried out by using a standardized procedure with the participants in a half-supine lying position after 5 minutes of rest [19].

Previous studies have shown that acupuncture needle stimulation for treating cardiovascular disorders should be carried out at the following acupoints: pericardium 5, 6 (P 5, 6), stomach 36 (ST 36), large intestine 4, 11 (LI 4, 11), bladder 18, 20 (BL 18, 20), and gallbladder 34 (GB 34) These points have been reported to have an effect on the cardiovascular parameters in patients with essential hypertension [20]. Thus, LI 4 and LI 11 acupoints were used in this study. Acupuncture treatment was carried out by a specialist physiotherapist who was a certified (by the Acupuncture Association of Chartered Physiotherapist, Peterborough, UK) acupuncturist who had had 10 years of clinical experience with physiotherapy practice using acupuncture in the management of musculoskeletal conditions.

In the RAG, participants assumed the half-lying supine position with proper pillow support under the head and neck and behind the knee joints for comfort. Needles were inserted into LI 4 and 11 (Fig. 2). The side of the body that was used for needling was determined by asking the participants to select one of two labels in a sealed envelope; on one label was written right side and on the other was written left side. At each acupoint, the skin was wiped with alcohol, and the therapist's hands were cleaned with alcohol gel prior to the insertion of disposable stainless-steel needles (0.2 mm × 40 mm; Seirin, UK). After insertion of the needles, the acupoints were manually stimulated by lifting, thrusting, twirling and rotating the needle to elicit *de qi*. The needle manipulation was stopped when participants felt *de qi* (*de qi*: numbness, soreness and/or

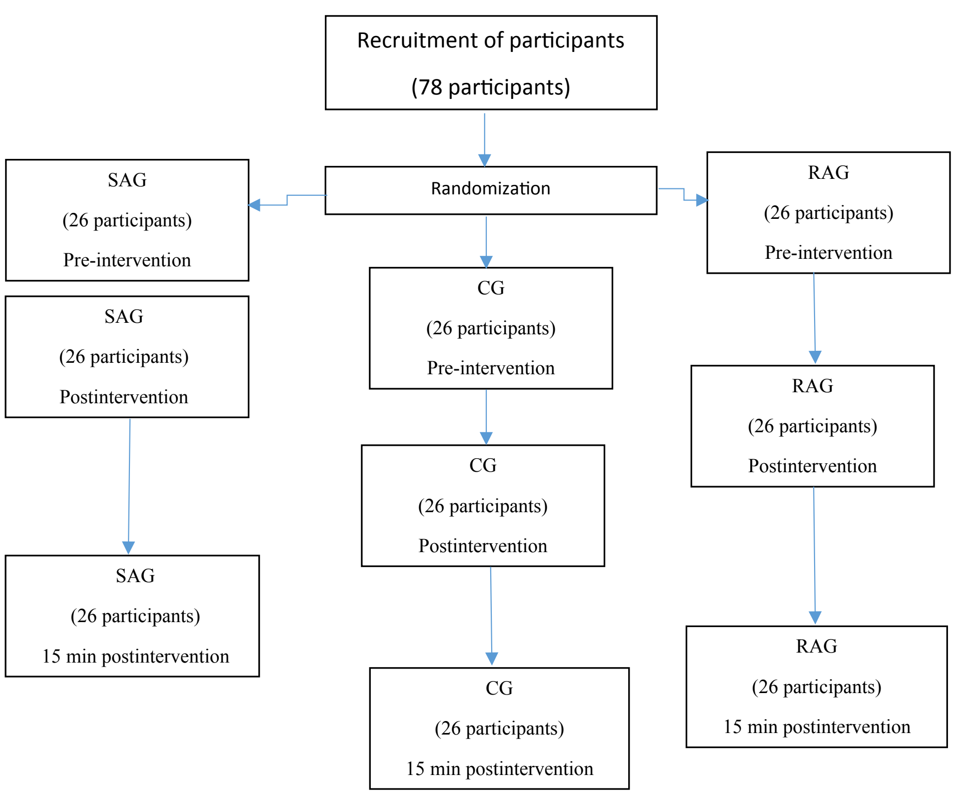

Figure 1 Methodological flow for the study. SAG = sham acupuncture group; RAG = real acupuncture group; CG = control group.

Figure 2 Acupuncture needle positioning at LI 4 and LI 11.

radiating sensation) [20]. The needle stimulation to elicit *de qi* was repeated at 5-minute intervals during the 30 minutes that the needles were left in position. In the SAG, participants' preparation and positioning were as described for the RAG. Needling was performed with the same technique as for RAG, but needling was carried out at acupoints without relevance to the treatment of cardiovascular disorders according to traditional Chinese medicine. The following prevalidated sham acupuncture points were used: halfway between the tip of the elbow and the axilla and halfway between the medial epicondyle of the humerus and the ulnar side of the wrist [21,22]. The needles were left in position for 30 minutes. In the CG, participants assumed a half-lying supine position with proper pillow support under the head and neck and behind the knee joints for comfort for 30 minutes, but no needling was carried out.

Postintervention outcomes were assessed by measuring the SBP, DBP, and HR after 15 minutes of acupuncture needle stimulation, immediately at the end of the 30-minute acupuncture needle stimulation (postintervention) and 15 minutes after the end of the acupuncture stimulation. Participants were also asked to describe in their own words the changes they perceived at the point of needle insertion, in the part of the body where the needles had been inserted, and in the whole body generally.

Given the nature of the intervention, blinding the participants and the therapist with respect to the content of the interventions was not possible. However, an investigator who was not aware of participant allocation into the groups carried out the data analysis. Statistical analyses were performed by using SPSS, version 14.0. Demographic variables, such as age, weight, height and body mass index (BMI), and outcome variables, such as SBP, DBP, HR, and rate pressure product (RPP: product of SBP and HR), are presented as means $\pm$ standard deviations while sex is presented as a frequency and a percentage. One-way analysis of variance (ANOVA) was used to compare age, weight, height, and BMI among the three groups. Normality of the data was assessed by using the Shapiro–Wilk test. A nonparametric Friedman ANOVA was used because of non-normal distributions to assess group differences over time in the SBP, DBP, HR, and RPP at all stages of data collection among the three groups. The Friedman ANOVA can be used when a regular ANOVA cannot be performed based on violations of assumptions such as normality. In addition, Mann–Whitney U tests were used to assess between-group differences in the changes in the parameters (postintervention − preintervention) between the RAG and the SAG. The significance level for all statistical tests was set at $p < 0.05$.

3. Results

Participants' demographic variables are presented in Table 1. Seventy-eight participants with an average age of 28.9 $\pm$ 7.65 years were involved in the study. Forty-four (56.41%) of the participants were male and 34 (43.59%) were female. Weight, height, and BMI did not show significant differences among the three groups ($p > 0.05$).

Forty (51.2%) of the participants reported heaviness of the upper extremity where the acupuncture needles had been inserted and 30 (38.46%) participants reported sensations of soreness and increasing pain at the sites of needle insertion. Only 20 (25.64%) of the participants reported numbness in the upper extremity where the acupuncture needles had been inserted, and 15 (19.23%) participants could not find the right words to describe their experience with the treatment even though they acknowledged feeling different while undergoing the acupuncture intervention (Fig. 3).

The SBP was reduced after 15 minutes of acupuncture intervention, immediately at the end of the 30-minute acupuncture intervention (postintervention) and 15 minutes after postintervention in the RAG and the SAG (Table 2). However, in the CG, the SBP remained rather unchanged at all stages of data collection (Table 2). Friedman's ANOVA test showed that the SBP did not differ significantly among the three groups at any stage of data collection ($p > 0.05$; Table 2). The DBP did not show significant differences between values measured preintervention, after 15 minutes of acupuncture, and postintervention among the three groups ($p < 0.05$). In the RAG, the HR was increased after 15 minutes of acupuncture (74.5 $\pm$ 4.67) and at postintervention (73.3 $\pm$ 5.45), but was reduced to near

Table 1 Characteristics of the participants.

		n(%)	Mean $\pm$ SD	F	p
Age (y)	RAG	26	29.52 $\pm$ 6.92		
	SAG	26	31.08 $\pm$ 6.95		
	CG	26	30.28 $\pm$ 4.04	0.215	0.102
Weight (kg)	RAG	26	65.11 $\pm$ 11.74		
	SAG	26	68.08 $\pm$ 6.95		
	CG	26	67.98 $\pm$ 2.04	0.921	0.402
Height (m)	RAG	26	1.69 $\pm$ 0.11		
	SAG	26	1.66 $\pm$ 0.08		
	CG	26	1.65 $\pm$ 0.02	6.782	0.202
BMI (kg/m^2)	RAG	26	22.56 $\pm$ 2.41		
	SAG	26	24.71 $\pm$ 2.51		
	CG	26	23.29 $\pm$ 1.88	17.377	0.502
Sex	Male	44 (56.41)			
	Female	34 (43.59)			

BMI = body mass index; CG = control group; RAG = real acupuncture group; SAG = sham acupuncture group; SD = standard deviation.

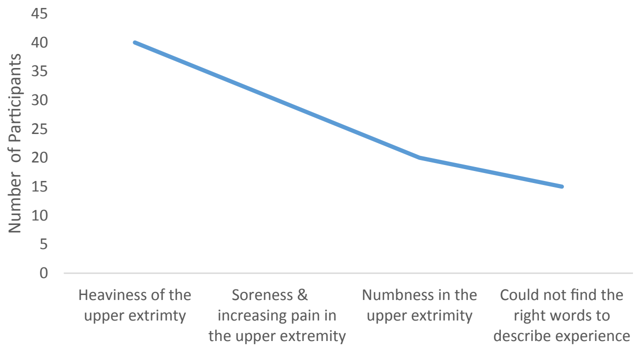

Figure 3 Participants' subjective experiences with acupuncture needle stimulation.

preintervention level at the assessment completed 15 minutes postintervention (66.9 ± 4.80). No increase in the average HR was recorded at any stage of data collection in the SAG and the CG (Table 2). HR scores showed statistically significant differences at all stages of data collection after preintervention assessment among the three groups (Table 2). In the RAG, the RPP scores increased from 8,177.2 ± 805.15 (preintervention) to 8,558.5 ± 114.69 (postintervention), but later decreased to 7,452.30 ± 868.77 at 15 minutes after postintervention. This was not the case with the SAG and the CG. The RPP scores showed significant differences after 15 minutes of acupuncture ($p = 0.003$) and 15 minutes after postintervention ($p < 0.001$) among the three groups (Table 2). Table 3 shows that the real acupuncture intervention caused statistically more reduction in the SBP ($z = -2.068$, $p = 0.037$), HR ($z = -2.656$, $p = 0.008$), and RPP ($z = -3.204$, $p = 0.001$), than the sham acupuncture did.

4. Discussion

The objective of this study was to investigate the experience of apparently healthy adult Nigerians with acupuncture needle stimulation and the responses of SBP, DBP, HR, and RPP to real acupuncture and sham acupuncture needle stimulation and to compare the changes in the SBP, DBP, HR, and RPP of the participants after 30 minutes of real acupuncture and sham acupuncture intervention. All the participants who were enrolled in the study completed assessments at all stages of data collection (Fig. 1). The majority of the participants in this study reported heaviness, numbness, and increasing pain during the acupuncture stimulation. However, no cases of dizziness and/or fainting were reported. None of the effects reported by the participants was life-threatening, and all typically were fleeting. Nevertheless, the therapist should inform patients of these possible side effects prior to acupuncture intervention so that if they experience any of them, they will know that such side effects are normal and nothing to be too concerned about as they will typically disappear within 24 hours [1]. Advice on eating before intervention and taking time in getting up and moving slowly after intervention might also be of benefit [1].

Analyses of changes, Δ (i.e., postintervention − preintervention scores), in the SBP showed a significantly greater reduction in the SBP in the real acupuncture ($\Delta X = -9.15$ mmHg, standard error of means = 1.60) than in the sham intervention ($\Delta X = -4.15$ mmHg, standard error of means = 1.01). Similar results were reported by Hazim et al [23]. Reports on SBP changes in response to acupuncture stimulation in healthy normotensive populations appear not to be many, thus limiting comparisons of this finding. However, data from other studies are

Table 2 Cardiovascular parameters in the real acupuncture group (RAG), sham acupuncture group (SAG), and control group (CG) at preintervention, 15 minutes after acupuncture, postintervention and 15 minutes postintervention.

		Groups				
		RAG	SAG	CG	F	*p*
	Preintervention	121 ± 10.69	118 ± 6.36	119 ± 10.0	4.145	0.115
SBP (mmHg)	15 min after acupuncture	115 ± 10.29	115 ± 5.09	115 ± 9.09	0.000	0.999
Mean ± SD	Postintervention	116 ± 14.35	115.1 ± 8.06	115 ± 7.65	1.176	0.341
	15 min postintervention	111.5 ± 9.24	112.3 ± 8.63	115 ± 5.09	1.385	0.257
	Preintervention	76.0 ± 8.96	73.0 ± 6.98	73 ± 00.0	7.455	0.101
DBP (mmHg)	15 min after acupuncture	76.9 ± 9.70	75.4 ± 9.04	73 ± 0.00	5.857	0.004
Mean ± SD	Postintervention	74.8 ± 8.03	74.0.1 ± 0.0	73 ± 0.00	5.952	0.004
	15 min postintervention	70.5 ± 0.24	70.3 ± 0.63	70 ± 0.09	0.000	0.999
	Preintervention	67.7 ± 5.29	71.8 ± 3.21	75.0 ± 1.01	2.651	0.100
HR (beats/min)	15 min after acupuncture	74.5 ± 4.67	71.6 ± 5.09	75.0 ± 0.00	6.526	0.001*
Mean ± SD	Postintervention	73.3 ± 5.45	71.2 ± 4.06	75.0 ± 1.01	6.329	0.003*
	15 min postintervention	66.9 ± 4.80	72.23 ± 3.63	76.0 ± 0.00	4.436	<0.001*
	Preintervention	8,177.2 ± 805.15	8,326.3 ± 521.99	8,630.0 ± 499.70	3.548	0.134
RPP	15 min after acupuncture	8,522.3 ± 498.84	8,244.6 ± 593.97	8,740.0 ± 387.50	0.369	0.003*
Mean ± SD	Postintervention	8,558.5 ± 114.69	8,193.1 ± 541.02	8,430.5 ± 458.91	1.485	2.233
	15 min postintervention	7,452.3 ± 868.77	8,115.4 ± 778.12	8,740.0 ± 387.52	26.353	<0.001*

*$p < 0.05$.
DBP = diastolic blood pressure; HR = heart rate; RPP = rate pressure products; SBP = systolic blood pressure; SD = standard deviation.

Table 3 Comparison of the mean changes (postintervention − preintervention) in the cardiovascular parameters between the real acupuncture group (RAG), sham acupuncture group (SAG).

Mean changes (postintervention − preintervention)	Group	*n*	Mean change	SEM	*z*	*p*
SBP (mmHg)	RAG	26	−9.15	1.60		
	SAG	26	−4.15	1.01	−2.068	0.037*
DBP (mmHg)	RAG	26	−6.00	1.76		
	SAG	26	−3.76	1.51	−0.874	0.382
HR (beat/min)	RAG	26	−1.07	0.94		
	SAG	26	0.30	0.24	−2.656	0.008*
RPP	RAG	26	−738.30	111.04		
	SAG	26	−251.692	89.43	−3.204	0.001*

*$p < 0.05$.
DBP = diastolic blood pressure; HR = heart rate; RPP = rate pressure products; SBP = systolic blood pressure; SEM = standard error of the mean.

available to support the view that neurovascular compression of the rostral ventrolateral medulla (rVLM) is associated with regulation of the SBP in patients with high blood pressure [14—16]. However, findings from those studies were largely heterogeneous for SBP changes. The two major contributors to blood pressure regulation have long been established to be the intrarenal renin—angiotensin system and chronic activation of the sympathetic nervous system. Recent evidence indicates that in some models of cardiovascular disease, blocking the AT1 receptors in the rVLM reduces sympathetic nerve activity and blood pressure, suggesting that the activity of the angiotensin system in this nucleus may play a role in blood pressure regulation and maintenance [24].

The neuroendocrine mechanisms of acupuncture in the regulation of blood pressure are not yet fully understood. However, previous studies have demonstrated that both low-frequency electroacupuncture (EA) and manual acupuncture inhibit blood pressure, as well as premotor sympathetic neural firing in the rVLM [25,26]. In addition, administration of naloxone (nonspecific opioid receptor antagonist) or gabazine (γ-aminobutyric acid type A receptor blocker) in the rVLM has been shown to eliminate the EA modulation [24]. Thus, the rVLM is an important brain stem region that processes somatic inputs during acupuncture stimulation [24]. Electrophysiological studies of the neuronal activity in the rVLM have shown that as compared to cardiovascular inactive points (LI 6-7, G 37—39), P 5—6 and certain acupoints along the large intestine meridian (LI 4—11), located over deep somatic neural pathways (median and deep radial nerves), provide more afferent input to cardiovascular premotor sympathetic neurons in the rVLM [24]. This observation is likely to be the reason that acupuncture needle stimulation at acupoints relevant to cardiovascular-related disorders is more effective in lowering elevated sympathetic outflow and SBP than needle stimulation at sham acupoints.

Furthermore, the central action of acupuncture may affect the opiate system. Endogenous opioids participate in depressurization induced by acupuncture [22]. The upregulation of the opioid system may regulate other neurotransmitter systems, such as the monoamine neurotransmitters (noradrenaline, dopamine, and serotonin), thus modulating the sympathetic activity and the blood pressure. Findings from studies in several models of hypertension suggested that EA and manual acupuncture lowered elevated BP through the release of opioids, γ-aminobutyric acid, nociceptin, and serotonin (or 5-hydroxytryptamine) in the rVLM [20—22]. Also, acupuncture inhibition of visceral reflex-induced hypertension in cats has been demonstrated to be related to the activation of μ- and δ-, but not κ-, opioid receptors in the rVLM, suggesting that endorphins, enkephalins, and perhaps endorphin, but not dynorphin, are mainly responsible for acupuncture modulation of cardiovascular responses [20—22].

The outcome of this study did not show significant differences in the changes in DBP between sham and acupuncture intervention. A similar result was obtained from a study that included 22 male and eight female normotensive individuals [23]. However, results of a study on hypertensive patients showed a significant ($p < 0.001$) decrease in DBP in the patient group after the last session of acupuncture intervention, and that reduction was still present after 3 months [23]. Other studies also reported significant reductions in the SBP and the DBP of patients with hypertension over 5 weeks of acupuncture needling in 30-minute sessions [20,21]. Considering the facts that the acupoints selected in this present study are the same as those used in previous studies involving individuals with high blood pressure where significant reductions in the DBP after acupuncture intervention were reported, perhaps acupuncture may adjust *abnormal*, but not *normal*, DBP.

The findings from this study showed an increase in the HR 15 minutes after needle insertion and immediately postintervention. Further analysis of the changes in HR showed that 30 minutes of acupuncture needle stimulation at acupoints relevant to the treatment of cardiovascular-related disorders produced significantly lower HRs than stimulation with needles at sham points. A similar trend of decreasing HR and RPP following application of transcutaneous electrical nervous stimulation applied over acupuncture points was reported in patients after recent open-heart surgery [27]. Thus, the hypotensive and the bradycardiac responses to acupuncture may be modified by related mechanisms within the central nervous system. The hypotensive and the bradycardiac responses to acupuncture are modified by the influences of L-arginine-derived neuronal nitric oxide synthesis in the gracile nucleus [23]. This finding may suggest that acupuncture can facilitate recovery of hemodynamic variables such as the HR and the RPP, which, in turn, may reduce myocardial work, thereby providing a useful adjunctive therapy in this regard.

Ethnic differences exist in the responses to different therapeutic measures capable of altering the cardiovascular parameters in humans [28]. The current level of evidence is not good enough to make unequivocal claims as regards to the cardiovascular responses to acupuncture and the efficacy of acupuncture for treating cardiovascular diseases among people of the black African race. The outcome of this study will contribute to knowledge in this area and might influence the choice of this therapeutic intervention in Nigeria and sub-Saharan Africa.

Three of the main limitations of this present study are the small sample size for the pilot study, the lack of a full intervention over a period of weeks and/or months, and the lack of follow-up after the treatment period. The reported findings might change if more individuals were recruited, if the treatment were administered over weeks and/or months, and if a post-treatment follow-up period were to be implemented. The therapeutic effects of the changes in the cardiovascular parameters observed in this study and the long-term effects of those changes are not known at the present time because the intervention and the follow-up period were insufficient. The use of acupuncture stimulation at two acupoints could be another limitation of the study. Most clinicians in acupuncture practice for blood pressure intervention normally will use more than two acupoints at a time. However, we decided to exercise caution by minimizing the number of stimulation points in order to avoid any side effects and/or adverse reactions because acupuncture needle stimulation was totally alien to the participants in this study. Another limitation might be the normal blood pressure population. However, the outcome of this study will be useful for planning future, large, randomized, controlled trials in which the effects of acupuncture will be investigated in participants with high blood pressure.

The participants in this study reported heaviness, numbness, and increasing pain, but no dizziness, fainting, and life-threatening side effects, during and after the acupuncture needle stimulation. Acupuncture on selected points relevant to cardiovascular disorders might be effective in reducing the SPD, the heart rate and the rate pressure products, but not the DPB, in normotensive apparently healthy Nigerian adults.

Disclosure statement

The author declares to have no conflicts of interest and no financial interests related to the material of this manuscript.

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