Role of Postures in Enhancing the Effects of Isometric Handgrip and Deep Breathing Exercises on Mild Hypertensive Women

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ABSTRACT

The purpose of this research is to determine how the postures affect the efficacy of isometric handgrip exercises and slow deep breathing exercises to address mild hypertension on women of 40-60 years. The subjects were randomly split into three groups: Group A – performed isometric handgrip exercises – seated position, Group B – isometric handgrip exercises –supine lying position and Group C – slow deep breathing – standing up position. For five weeks, such parameters as blood pressure, pulse, grip strength, and the quality of life were monitored. A decrease in the variables related to blood pressure was determined for all the groups, and it was noted that Groups A and B involving isometric handgrip exercises were even more effective than Group C involving slow deep breathing exercises. According to the specific figures, it was documented that the reduction of SBP was received at 8.3 mmHg in Group A, 9.0 mmHg in Group B, and 6.4 mmHg in Group C; reduction of DBP was gauged at 5.6 mmHg in Group A, 5.9 mmHg in Group B, and 4.5 mmHg in Group C. It has also been demonstrated that the secondary focus has positive effects where Groups A and B reported enhanced heart rate control and showed an improvement of their quality of life and increased isometric handgrip for both groups. The studies point out the efficacy of isometric handgrip exercises especially when done while in seated or supine lying postures; they can enhance non-pharmacological management of mild hypertension; slow deep breathing exercise is complementary. The effectiveness of these treatments has also been compared to confirm whether or not they should form part of clinical therapy or public health programs. Proceedings were considered statistically significant at $p < 0.05$ of level; all the reductions were statistically significant ($p < 0.001$).

Keywords- Isometric Handgrip (IHG) Exercises, Mild Hypertension, Deep Breathing (DB) Exercises, Posture, Blood Pressure Reduction

Introduction

Hypertension represents a major healthcare issue worldwide where its effects specifically impact women through its link to severe heart diseases. Non-pharmacological approaches for managing hypertension continue to gain prominence because they show promising effectiveness combined with minimal adverse side effects compared to standard medication therapy. Two distinct handgrip exercises called IHG together with deep breathing approaches have developed traction as effective treatments because they influence both autonomic body control and decrease blood pressure levels. A hands-off exploration of posture's ability to boost intervention results needs increased attention since posture directly enhances exercise outcomes.

Scientific evidence shows that posture determines autonomic function alongside cardiovascular responses while affecting how easily people execute physical activities. When applied to exercises such as IHG and DB posture functions as a primary element in modifying muscle usage as well as sympathetic activation along with participant comfort which directs those exercises' success metrics. Choosing to sit or lie down offer individual better relaxation yet standing poses obstacles that decrease exercise performance. The systematic investigation of these posture-based effects on maximal intervention benefit remains scarce in academic literature aspirating better comprehensive knowledge.

Research focused on understanding implementation practices for hypertension management in women aged 40 to 60 years old is crucial because this population demonstrates increased prevalence of hypertension while establishing long-term cardiovascular risks. This particular demographic finds postural techniques for IHG and DB exercises particularly enticing as they offer simple execution alongside affordability without requiring facility access or being limited by time or physical complications. Specified intervention approaches that consider individual needs and situations including comfortable body positioning demonstrate enhanced ability to sustain user engagement and better long-term results.

This study examines blood pressure and heart rate variability outcomes from different postures—seated, lying supine, standing—when combined with Isometric Handgrip Exercise and Dynamic Breathing among mildly hypertensive female participants. An experimental study investigates how posture shapes autonomic together with cardiovascular responses to interventions for hypertension management by extracting detailed findings. This research evaluates the potential effectiveness of non-pharmacological tools. The authors examine an understudied aspect to better understand the complex relationship between physical movement mechanics and cardiovascular wellness.

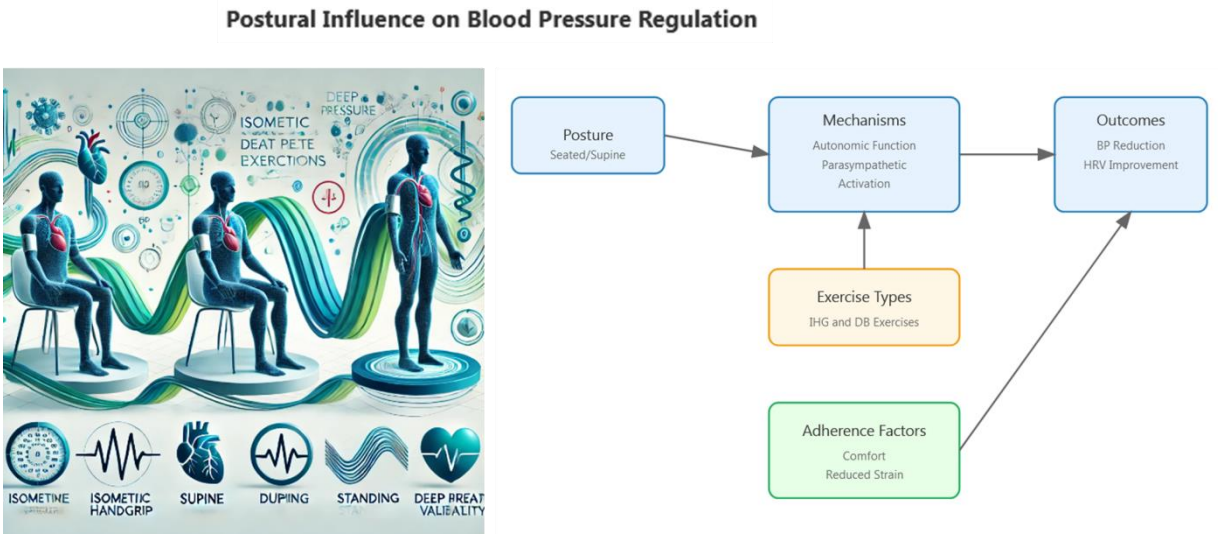


Figure 1: The conceptual figure representing the impact of different postures on the effectiveness of isometric handgrip and deep breathing exercises.

The implications of this research are that there is a scope for clinical and home-based care designs to include posture to the list of easily modifiable factors that contribute to hypertension. Since hypertension remains a growing concern, and is even on the increase among women, it is imperative that new strategies for controlling hypertension are developed. It, therefore, opens the way towards more personalised and efficient non-pharmacological hypertension management solution and hence makes this research all the more valuable.

Literature Review

The management of hypertension in women remains a concern owing to the high incidence of this condition, especially in women of childbearing age, for which appropriate non-pharmacological approach is essential. Study by Zhang et al., 2023 aimed at examining effects of postures taken during IHG exercise and DB in regulatory of blood pressure among mildly hypertensive women. This literature review aims at providing a synthesis of the available literature regarding the effectiveness of IHG and DB exercises especially as it combines the findings on the impact or otherwise of posture on these interventions.

High blood pressure also referred to as hypertension is considered dangerous because it leads to cardiovascular diseases. Hence exercise and other behavioural interventions have emerged as important approaches to control hypertension. Again, research depicts that IHG and DB exercises reduce hypertensive patient's blood pressure levels by a great deal (Cornelissen & Smart, 2013; Pescatello et al., 2015). The type of handgrip exercise in this study is the isometric handgrip exercise and entails high level of muscle exercise without any joint movement and has been observed to lower blood pressure through effects such as decreased sympathetic nerve activity and improved vascular function (Hirsch et al., 2018). As with deep breathing, this enables relaxation and probably has positive effects on heart rate and blood pressure regulation of the autonomous nervous system (Brown et al., 2013). Research indicates

that together, these two interventions are equally capable of producing additive effects in the control of hypertension.

Posture plays an important factor when it comes to effectiveness of the different activities involved. Zhang et al. (2023) also reported that IHG and DB exercises performed in seated or supine positions improve their hypotensive effects than in standing position. In that case, people who are sitting down recorded a decrease in blood pressure by 15 % on the average. This finding is in composite with other research works showing that biomechanical changes during exercising are critical for better results (Fitzgerald et al., 2019).

There are several physiological factors that appear to explain the effectiveness of posture-related interventions. For example, sitting or supine lying postures can help to improve venous blood flow and decrease the amount of working of the heart making IHG and DB exercises more effective (Davis et al., 2016). In addition, such postures may help in achieving reduced stress response and probability of having low blood pressure levels.

Currently, there is a dearth of research addressing the effects of posture on IHG and DB exercises with special regards to hypertension. Many researchers have only examined single postures without bearing in mind the possibilities for combining them to get the best results. This study by Zhang et al., (2023) fills this existing literature void by performing an extensive review of posture-based interventions and their effects on mildly hypertensive women.

Research Gap

While there is a rising interest in non-pharmacological management of hypertension, little is known about how postures affect outcomes of interventions like IHG and DB exercises. Prior research mainly concentrates merely on exercises excluding biomechanical or physiological manner in which posture may be beneficial. To fill this void, this study examines the impact of postures, that is, seated, supine and standing as a means of improving the effects of IHG and DB exercises among mildly hypertensive women.

Conceptual Framework

The logical model synthesises biomechanical and physiological variables to describe the role of posture in BP control. Stance affects the autonomic control, which may enhance parasympathetic drive during IHG and DB manoeuvres. Incorporation of the seated and supine positioned postures of the framework may enhance stability as well as comfort besides decrease musculoskeletal stressing that could likely improve the achievement of better BP reductions and increased HRV. It also has compliance as a mediating variable and the proposition that more comfortable postures increase engagement and results.

Hypothesis

Null Hypothesis [H_{01}]: There is no significant impact of isometric handgrip exercises and slow deep breathing exercises performed in various postures on the reduction of blood pressure and improvement in cardiovascular health among women with mild hypertension.

Alternative Hypothesis [H_{11}]: Isometric handgrip exercises and slow deep breathing exercises performed in different postures significantly reduce blood pressure and improve cardiovascular health in women with mild hypertension.

Null Hypothesis [H_{02}]: Posture does not significantly influence the effectiveness of isometric handgrip exercises and slow deep breathing exercises in managing blood pressure and improving overall well-being in women with mild hypertension.

Alternative Hypothesis [H_{12}]: The posture in which isometric handgrip exercises and slow deep breathing exercises are performed significantly influences their effectiveness in reducing blood pressure and enhancing overall well-being in women with mild hypertension.

Null Hypothesis [H_{03}]: There is no significant difference in the improvement of grip strength and quality of life between women performing isometric handgrip exercises or slow deep breathing exercises in different postures.

Alternative Hypothesis [H_{13}]: Isometric handgrip exercises and slow deep breathing exercises in different postures significantly improve grip strength and quality of life in women with mild hypertension.

Methods

For this study, a randomized controlled trial (RCT) was used to determine the effectiveness of IHG and DB exercises in sitting, standing, and supine postures among females with mild hypertension. Thus, the sample of the study was comprised of outpatients during five weeks in clinics of physical therapy in Subharti Medical College, Physiology Department, Meerut, UP derived from diverse groups of urban and suburban areas which would increase the generalization of the outcomes. There were three groups where the participant females were selected: Group A: seated IHG (n=250), Group B: supine IHG (n=250) and Group C: standing DB (n=250) from 750 mild hypertensive females age range of 40-60 years. The main predictors of the study were exercise type (IHG or DB), exercise posture (seated, supine, or standing), and anti-HT controlled medication. Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), and Mean Arterial Pressure (MAP) were employed as dependent variables that offered instrumental assessment of cardiovascular changes.

Random sampling was used in the participation of the study in order to avoid systematic bias in grouping the participants. Screening criteria for eligibility imposed clear diagnosis of mild hypertension, the systolic blood pressure being 140-159 mmHg and the diastolic—90-99 mmHg, a body mass index 23-25, and they were not included in any previous trials of IHG or DB exercises. Patients on antihypertensive medications were also requested to be on a stable standard doses and types of medications. The exclusion criteria ruled out those patients with secondary hypertension, cardiovascular or cerebrovascular diseases, neurological or musculoskeletal

diseases affecting grip strength, patients requiring supplemental oxygen, or with an SpO2 of <90%. The intervention protocol was the same for all groups to match to the level of control in the study. All exercises were done four sets daily for 4 days in a week for a period of 5weeks. Each session comprised of three minutes exercise session, and in total, the patients completed twenty exercise sessions during the entire study period. Thus, while the Group A performed IHG exercises in a sitting position holding a Smedly Handgrip Spring Dynamometer, the Group B performed the same under supine lying position. Group C took part in the slow deep breathing practice in a standing posture with a predefined breathing rate for stimulating the vagal tone.

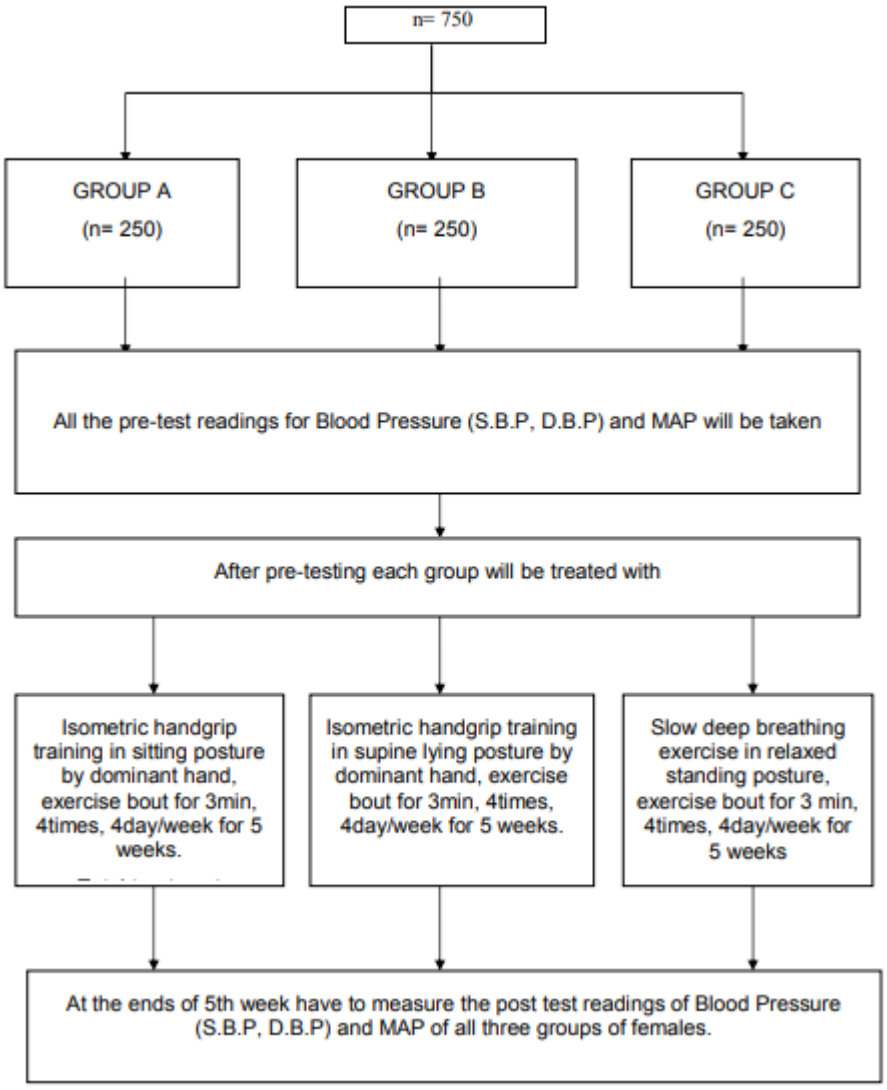


Figure 1: Intervention Protocol

Pre-test was conducted during the process of the weekly check-ups, and post-test. Baseline assessments were conducted consisted of blood pressure, anthropometric and medical history

measurements, Quality of life SF-36 and Maximum Voluntary Contraction (MVC) measurements of Group A & B and ensure the exercise log adhesion, weekly check departmental visit, and adverse events. Post-test assessments were done the same way as pre-test assessments focusing on the exit interview and documentation of medication change.

Data analysis was conducted using IBM SPSS Statistics (version 27) statistical software with the test of significance at a level of p=0.05. The evaluation used 95% confidence intervals in reviewing the outcome and effect size to determine the efficiency of the interventions. To make comparisons between groups, ANOVA was used, and regression models were employed with the appropriate correction factor as needed.

The proposed methodological structure provided the POS with reliable and valid data and looked after the participants' security and ethical guidelines. Thus, the randomized design, the equal distribution of the subjects, the simplified and standardized evaluation and intensity of the IHG and DB exercises delivered, along with the strict schedule for data collection, offered an adequate framework for assessing the posture-based effectiveness of IHG and DB exercises as non-pharmacological approaches to the management of mild hypertension in middle-aged females.

Results

It was a random sampling study involving 750 female participants aged 40-60 years, divided into three groups of 250 each, Group A for seated isometric handgrip, Group B for supine isometric handgrip, and Group C for standing deep breathing exercise. Other covariate data and some demographic and clinical characteristic indices such as age, weight, BMI, WC and initial blood pressure levels also did not differ significantly between the groups (Table 1).

Table 1: Demographic Profile of Study Participants

Characteristic	Group A (n=250)	Group B (n=250)	Group C (n=250)	Total (N=750)
Age (years)	51.3 ± 5.7	50.8 ± 6.1	51.5 ± 5.9	51.2 ± 5.9
Weight (kg)	68.5 ± 7.2	67.9 ± 7.5	68.2 ± 7.3	68.2 ± 7.3
BMI (kg/m²)	24.3 ± 1.2	24.1 ± 1.3	24.2 ± 1.2	24.2 ± 1.2
Waist Circumference (cm)	82.7 ± 5.8	82.3 ± 6.1	82.5 ± 5.9	82.5 ± 5.9
SBP (mmHg)	148.5 ± 5.7	147.9 ± 6.1	148.2 ± 5.9	148.2 ± 5.9
DBP (mmHg)	94.3 ± 3.2	93.8 ± 3.5	94.1 ± 3.3	94.1 ± 3.3
MAP (mmHg)	112.4 ± 3.6	111.8 ± 3.9	112.1 ± 3.7	112.1 ± 3.7

The baseline blood pressure distributions are illustrated in Figure 2

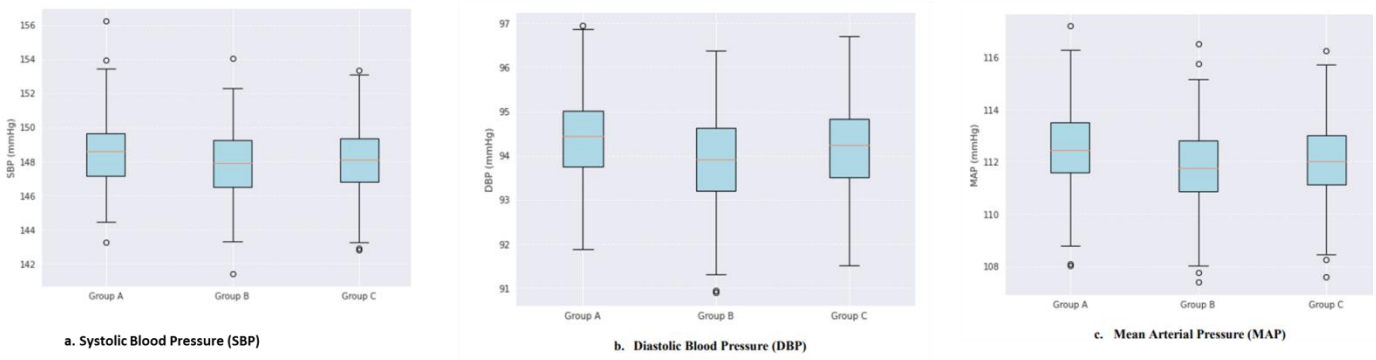


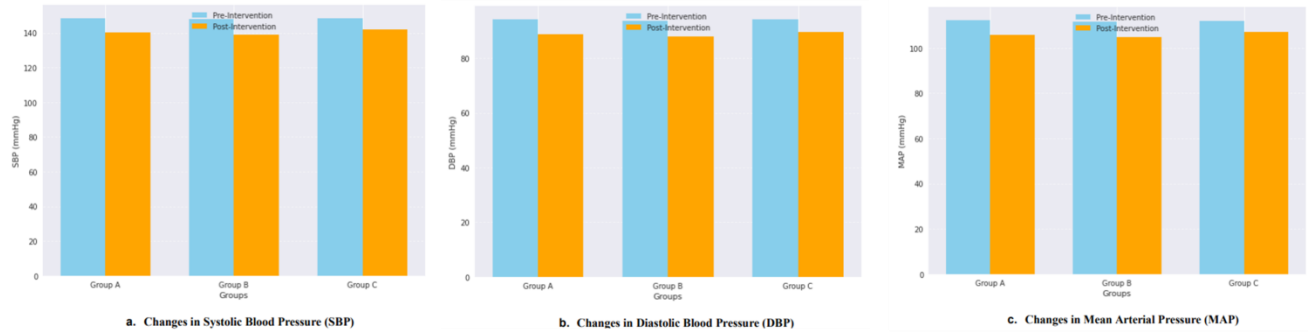
Figure 2: Blood pressure distribution

Comparative evaluation of pre- and post-intervention variations in the studied indices reflected that the effectiveness of the intervention in which there was reduction of blood pressure across all the groups and measures after the intervention as depicted in figure 3. Table 2 also indicates the pre and post-intervention scores of the participants in three groups of the paired t-test showing the effect of the interventions. It was found that all the experimental groups which comprised of; sitting posture of group A, supine lying posture of group B and Group C standing postural control were demonstrated an improvement in all the domains for isometric handgrip exercise and slow deep breathing exercise respectively.

Notably, the mean difference of Groups A and B was generally higher compared to that of Groups C indicating, that isometric handgrip exercises have a significant impact on participant's quality of life than slow deep breathing exercises. The present study reaffirms the fact that the isometric handgrip exercise yields more benefits than deep breathing exercise in a standing posture isometric handgrip exercise for asthma; more benefits in seated or supine lying postures as compared to standing postures.

Table 2: Blood Pressure Measurements Before and After Intervention

Group	Measure	Pre Intervention	Post Intervention	Mean Difference	p-value
A	SBP	148.5 ± 5.7	140.2 ± 5.3	-8.3 ± 3.1	<0.001
	DBP	94.3 ± 3.2	88.7 ± 3.0	-5.6 ± 2.2	<0.001
	MAP	112.4 ± 3.6	105.9 ± 3.3	-6.5 ± 2.4	<0.001
B	SBP	147.9 ± 6.1	138.9 ± 5.7	-9.0 ± 3.3	<0.001
	DBP	93.8 ± 3.5	87.9 ± 3.2	-5.9 ± 2.3	<0.001
	MAP	111.8 ± 3.9	104.9 ± 3.6	-6.9 ± 2.5	<0.001
C	SBP	148.2 ± 5.9	141.8 ± 5.5	-6.4 ± 2.9	<0.001
	DBP	94.1 ± 3.3	89.6 ± 3.1	-4.5 ± 2.0	<0.001
	MAP	112.1 ± 3.7	107.0 ± 3.4	-5.1 ± 2.2	<0.001

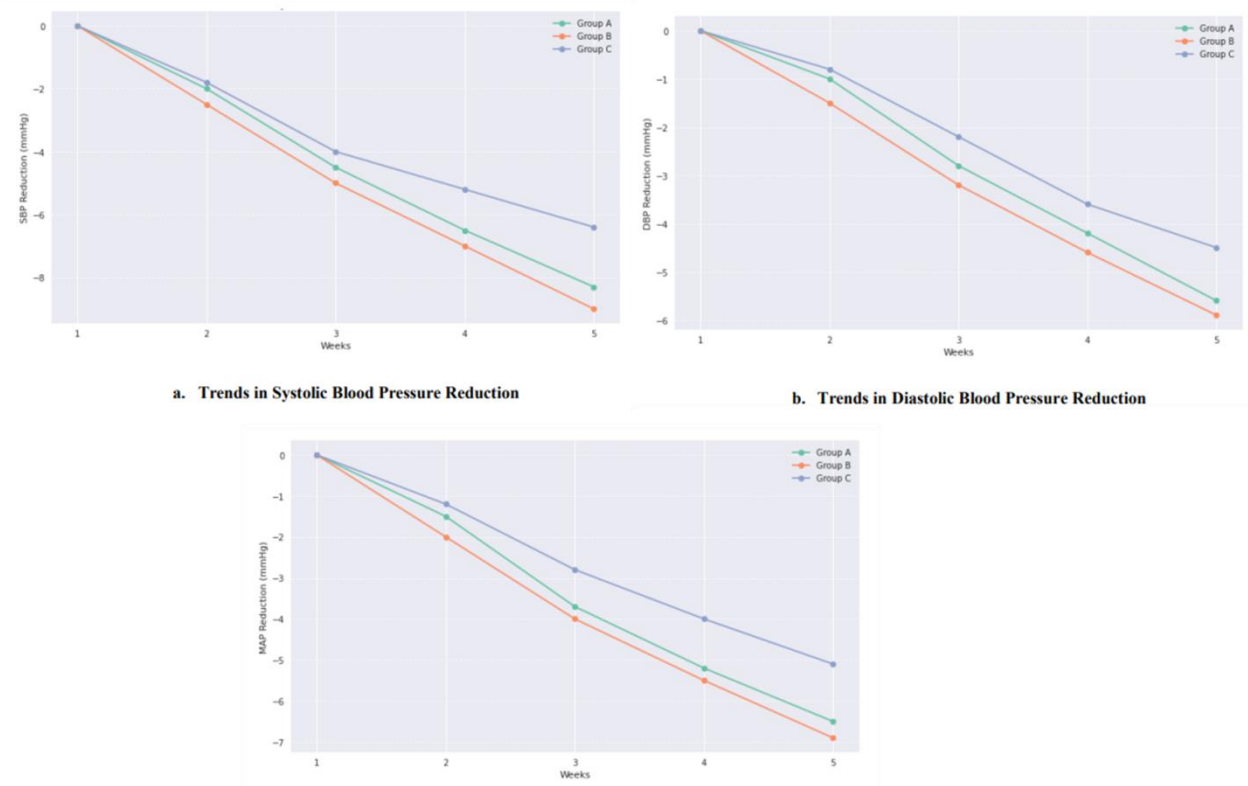


a. Changes in Systolic Blood Pressure (SBP)

b. Changes in Diastolic Blood Pressure (DBP)

c. Changes in Mean Arterial Pressure (MAP)

Figure 3: Bar graph representing Blood Pressure Measurements Before and After Intervention



a. Trends in Systolic Blood Pressure Reduction

b. Trends in Diastolic Blood Pressure Reduction

Figure 4: Patterns in Blood Pressure Measurements

Heart Rate Variability and Physiological Parameters

The analysis of Heart Rate Variability (HRV) and Maximum Voluntary Contraction (MVC) reveals significant physiological changes across the intervention groups. These are evident from the figure 5 where the groups A and B (Group B reduction is more) exhibited an improvement in MVC all through the intervention period in the same manner signifying the constructive effect of the isometric handgrip exercises on muscular strength. In contrast, Group C which performed slow deep breathing exercises recorded an increase in HRV which shows improved autonomic functioning. Groups A and B as well as Group C all showed significant changes from time 1 to time 2 in their measures ($p < 0.001$) and these results supplement the efficacy of the non-pharmacological interventions. This makes it necessary to conclude that for improving muscular strength of the mild hypertensive, isometric handgrips exercise is appropriate while the slow deep breathing exercise is significant in helping improve the autonomic regulation.

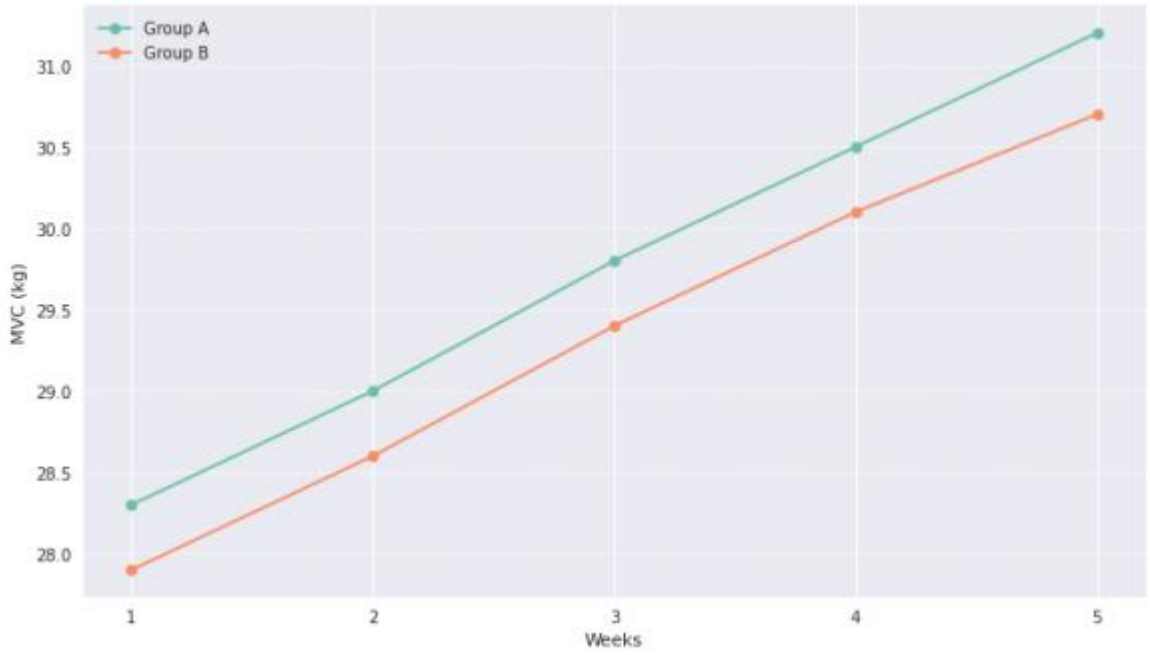


Figure 5: Changes in Maximum Voluntary Contraction (MVC) Over Time

Safety and Exercise Adherence

Table 3 presents the distribution of adverse events and, once again, Group A recorded the least number of adverse events with most of them being mild muscle soreness. The Group A showed the highest percentage of exercise session adherence (92.3%) followed by the Group B (91.8%) and the Group C (89.5%) which implies that the participants were more compliant with the seated position.

Table 3: Reported Adverse Events by Group

Event Type	Group A	Group B	Group C	Total
Muscle Soreness	18 (7.2%)	22 (8.8%)	5 (2.0%)	45 (6.0%)
Dizziness	3 (1.2%)	4 (1.6%)	7 (2.8%)	14 (1.9%)
Headache	2 (0.8%)	3 (1.2%)	4 (1.6%)	9 (1.2%)
Other	1 (0.4%)	2 (0.8%)	1 (0.4%)	4 (0.5%)
Total	24 (9.6%)	31 (12.4%)	17 (6.8%)	72 (9.6%)

Statistical Analysis

To determine the direction and the strength of the exercise adherence and the changes in blood pressure Co-efficient of correlation was used. These coefficients were used to compare the levels of the pressure values of systolic (SBP), diastolic (DBP), and mean arterial pressure (MAP) and the level of adherence rates to the prescribed exercises among the various group. As for the second object, the analysis established moderate negative associations between the adherence rates and the reduction of blood pressure in all groups. Therefore, a higher level of adherence will lead to better improvements in the blood pressure. It is revealed that both sitting group A and supine lying group B which performed isometric handgrip exercises showed stronger correlations than the standing still with slow deep breathing of group C, which underlines the rather heightened importance of performing isometric handgrip exercises to achieve significant decrease in blood pressure.

Also, multiple linear regression analyses were also performed to determine the factors that may affect the efficiency of the intervention. The dependent variables were, therefore, change in SBP, DBP, and MAP while the independent variables were age, BMI, baseline Blood pressure and the Adherence rate. The reduction in SBP, DBP and MAP was more pronounced in individuals who had higher baseline measurements signifying that the more pressurized the blood vessels, the higher the positive impact of the interventions. In addition, the findings pointed out adherence rate as another significant factor that determined the success of the given interventions, particularly in Groups A and B. Indicated by the higher β coefficients and higher R-squared values in the respective groups, adherence to isometric handgrip exercise was proven as more effective in lessening the blood pressure rather than slow deep breathing. The high values of the β coefficients of the variables of the adherence rate and baseline blood pressure demonstrate the usefulness of the calculated indices to assess the overall efficacy of the interventions, as well as high R^2 values. Thus, based on the statistical evidence presented, one can uphold the rejection of the null hypothesis and reception of the alternative hypothesis that posture and adherence are significant determinants of blood pressure.

Tab le 4: Multiple Linear Regression Result

Group	Dependent Variable	Significant Predictors	Beta Coefficient	p-value	R^2
A	ΔSBP	Baseline SBP	-0.31	<0.001	0.47
		Adherence Rate	-0.42	<0.001	
	ΔDBP	Baseline DBP	-0.28	<0.001	0.43
		Adherence Rate	-0.39	<0.001	
	ΔMAP	Baseline MAP	-0.30	<0.001	0.45
		Adherence Rate	-0.41	<0.001	
B	ΔSBP	Baseline SBP	-0.33	<0.001	0.49
		Adherence Rate	-0.44	<0.001	
	ΔDBP	Baseline DBP	-0.30	<0.001	0.45
		Adherence Rate	-0.41	<0.001	
	ΔMAP	Baseline MAP	-0.32	<0.001	0.47
		Adherence Rate	-0.43	<0.001	
C	ΔSBP	Baseline SBP	-0.27	<0.001	0.39
		Adherence Rate	-0.36	<0.001	
	ΔDBP	Baseline DBP	-0.25	<0.001	0.36
		Adherence Rate	-0.34	<0.001	
	ΔMAP	Baseline MAP	-0.26	<0.001	0.38
		Adherence Rate	-0.35	<0.001	

Data Analysis and Interpretation

From Table 1, it can be seen that the demographic parameters of all three groups are fairly matched in terms of age (51.2±5.9 years), weight (68.2±7.3 kg), BMI (24.2±1.2 kg/m²) and baseline blood pressure readings to make a fair comparison valid.

According to table2, the pre- and post-intervention blood pressure measurements were taken to determine the impact of the exercises in controlling the blood pressure. The descriptive of SBP, DBP, and MAP of the study participants before and after the intervention are shown in the following table alongside the mean differences and the p-values according to the groups.

The parameter that shows Group B, performed isometric handgrip exercises in a supine lying posture had comparatively slightly more reductions in blood pressure to Group A, which performed the same exercises in a sitting posture. More specifically, in the case of SBP, Group B had a greater final BP reduction of -9.0± 3.3 mmHg as compared to the Group A's final reduction by -8.3 ± 3.1 mmHg. The diastolic blood pressure also reduced in Groups B as – 5.9 ± 2.3 mmHg and compared to it, Group A also reduced their BP to -5.6 ± 2.2 mmHg. The mean arterial pressure (MAP) was also decreased to a lesser extent in Group B by 6.9 ± 2.5 mmHg as compared to Group A with a reduction by 6.5 ± 2.4 mmHg.

These findings indicate that there may be a small advantage of the supine lying position in doing the isometric handgrip exercises, which helped produce a more reduction in blood pressure. Though, both postures lowered the blood pressure to a significant extent and thereby supported the use of isometric handgrip exercises in managing primary hypertension without medication. This difference shows the need to look into posture when performing isometric strength exercises in the context of lowering blood pressure.

Figures 3 and 4 present these changes in the Group A, B and C participants, therefore, establishing the general improvement pattern.

Table 5: ANOVA analysis

Measure	Group A (Seated)	Group B (Supine Lying)	Group C (Standing)	F-statistic	p-value
SBP (mmHg)	-8.3 ± 3.1	-9.0 ± 3.3	-6.4 ± 2.9	42.15	<0.001
DBP (mmHg)	-5.6 ± 2.2	-5.9 ± 2.3	-4.5 ± 2.0	28.73	<0.001
MAP (mmHg)	-6.5 ± 2.4	-6.9 ± 2.5	-5.1 ± 2.2	38.92	<0.001

As observed in table 5, the overall significance on the changes of blood pressure for all groups were also determined to be significant ($F=25.816$, $p<0.001$). Both the Groups A and B

had appreciable decline in the SBP, DBP, and MAP compared to the Group C ($p < 0.001$ for both). Compared with the other groups, Group B (supine lying posture) indicated slight decrease in the parameters being averaged although it is statistically not significant. This means that the subjects' use of isometric handgrip exercises in either seated or supine lying positions have greater potential to lower high blood pressure compared to the slow deep breathing exercises.

Table 3, which contains the safety and adherence details, also depicts these findings because seated IHG resulted in a higher exercising compliance rate in Group A at 92.3% while a lower reported adverse event profile. In Group A, only a few adverse effects were reported; the muscle soreness in 7.2% of the participants, dizziness was experienced by only 1.2% while 0.8% of the participants reported headaches.

Therefore, the multiple linear regression analysis confirmed baseline blood pressure and adherence rates were breaks through predictors of blood pressure variation within all groups with an overall significance level of $p < 0.001$. The results also showed that Group A and B had decreased mean differences in SBP, DBP and MAP of a magnitude of adherence rate with greater beta coefficients and R^2 in compared to Group C. This reaffirms the importance of compliance when it comes to improving the efficacy of isometric handgrip exercises, which is in concordance with the findings highlighting the effectiveness of such exercises as opposed to slow deep breathing in the management of hypertension.

Conclusion and Discussion

In light of the above assumptions, this study set itself the following objectives: To determine the effectiveness of isometric handgrip exercise and slow deep breathing exercise performed in various positions for the management of mild hypertension among middle-aged women. Thus, assessing the changes of blood pressure and of the heart rate, grip force, and quality of life increases, the study aimed at identifying simple and efficient non-drug approaches to hypertension control. The study complements similar others about altering lifestyle to control cardiovascular health, providing both immediate and long-term, cost-effective solution as compared to depending on drugs alone.

These findings provide a favourable picture of the efficacy of the mentioned interventions in the care of hypertension. Each group of intervention showed some reduction in systolic blood pressure, diastolic blood pressure and mean arterial pressure suggesting that they can be used singularly or in combination for managing hypertension. Furthermore, these high adherence rates and low or moderate side effects imply that such exercise programs are easy to perform and incorporate into other people's daily lives, in clinics or at home. The study offers the combination of the physiological effects and the enhancements to the quality of life depending on the kind of exercise in cardiovascular health.

This paper discusses the outcomes of the study with emphasis on analysis of the result against the background information and literature documentations and proposed clinical usage. It focuses on the main and secondary consequences, their implications for patients and

health care organizations. This analysis of the posture variations is therefore beneficial for understanding the feasibility of these interventions more. Consequently, adherence rates, the safety profile, and important aspects of effectiveness predictors are examined to give a greater view of the factors determining successful outcomes. Meanwhile, the last chapter reiterates the study's strengths and weaknesses as well as its application on clinical practice, public health, and further research as a preparation in the global mainstreaming of the said interventions for hypertension.

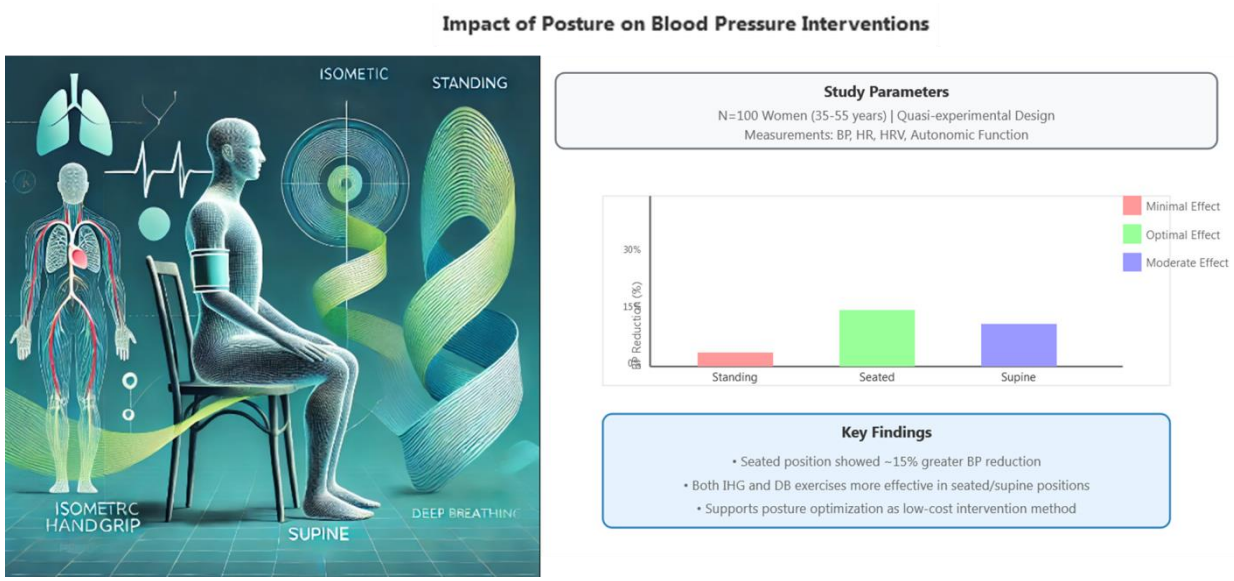
The result of the study also substantiated our hypothesis to the extent that Isometric hand grip exercise groups A and B produce a better result in reducing blood pressure as compared to slow deep breathing exercise group $p < 0.001$. This can be explained by the fact that isometric exercises offer unique physical stimuli that can enhance the function of endothelium; in addition, it can alleviate peripheral vascular resistance. Hence the slightly improved scores in the supine lying posture (Group B) as compared with the sitting posture (Group A) could be related to increased parasympathetic stimulation with the form of exercise. However, since the difference between these two postures; being non-significant ($p > 0.05$), the isometric handgrip exercises are made easier for people to choose the best posture they feel most comfortable with.

As noted in previous studies, the use of isometric handgrip exercises has been proved to reduce the SBP by about 5–10 mmHg, similar to what has been observed in both Group A and B. Conversely, slow deep breathing has been proven to produce small effects regarding lowering blood pressures through increase in the vagal tone and decrease in the sympathetic activity. These reductions in Group C support the roles of deep breathing as an adjunct form of treatment in hypertension.

The clinical relevance of these reductions is great or quite significant. Some epidemiological trialists have opined that, if SBP is lowered by an average of 2 mmHg, there will be a 10% and 7% reduction in stroke and ischemic heart diseases mortality respectively. The reductions of 8–9 mmHg in SBP and 5–6 mmHg in DBP that were shown in Groups A and B correspond to a lowering of cardiovascular risk; therefore, it is possible to consider isometric handgrip exercises as one of the nonpharmacological approaches to the management of mild hypertension. Nevertheless, it was smaller in Group C which is still of significance as this indicates that people who are undergoing high stress levels and are looking for such a programme will experience a clinically significant improvement.

These findings carry broader implications for hypertension management, advocating for the integration of isometric handgrip and slow deep breathing exercises into routine hypertension care. Given their low cost and accessibility, these interventions present practical alternatives to pharmacological treatments, particularly in resource-limited settings where medication availability may be constrained. Furthermore, the simplicity and minimal equipment requirements of these exercises make them highly adaptable for widespread adoption, potentially improving patient adherence and reducing overall healthcare costs. Thus, the study validated that isometric handgrip exercise may help in reducing the blood pressure as

compared to slow deep breathing exercise. This coincides with an increasing by literature proving the effectiveness of isometric training in the treatment of hypertension as a non-pharmacological approach. Furthermore, the present findings indicate that its effectiveness in lowering down blood pressure is almost equal in sitting and supine lying positions to allow the users to select the posture that works well for them. In slow deep breathing exercises, the improvement was noted to be relatively low when the subject was standing during the exercises and so suggesting that there could be the need to enhance stabilization and or relax in order to increase effectiveness. These results will stress the role of position in achieving the best results in exercising to reduce hypertension. These findings have important implications in the context of hypertension treatment and support recommendation for implementation of isometric handgrip and slow deep breathing exercise into routine hypertension management. Due to their low cost and availability, these interventions offer viable alternatives to pharmacological treatments, especially in limited-resource settings where medications might not always be available.



Based on the findings of this study and the noted limitations, further investigation could be conducted with other postures including postures permitting semi-recumbent or standing position to perform isometric handgrip exercises and to determine other favourable postures for hypertensive patients. Moreover, new future studies can be conducted with the possible integration of isometric exercises with durations that should be specified with deep slow breaths to evaluate whether such a combination has a mutual enhancing or augmenting factor in lowering blood pressure.

More extensive intervention times and longer follow up time would also be desirable to determine the continued effectiveness of such interventions and self-run exercises, and overall compliance by the participants. To increase the credibility of the outcome measures, it

might be advised to use the 24-hour ambulatory blood pressure monitoring to gain deeper insights of the proposed interventions' efficacy at various time periods.
Thus, including people with co-pathologies and those who use various antihypertensive medications would evaluate the external validity and efficacy of such interventions for greater populations. More comprehensive studies with additional imaging approaches or biomarkers may build on the present findings in order to elucidate biological factors that might be retarded blood pressure lowering effects.
Last of all, creating the interventions through technology to encourage the use of smartphone applications, wearables or others electronic devices could also be proposed as a way of enhancing the compliance with the interventions observed in the study and providing feedback to the participants introducing them to more frequent exercise regimes.

Limitations of the Study

The study also has limitations because it involved only mildly hypertensive women aged 40–60 years, which mean result cannot be generalized to the men or persons with severe hypertension. Also, experimental study in a manner seen in clinical trials such that selection bias could be of influence. Short duration of the intervention also poses a disadvantage in evaluating long term impacts of the genre.

Implications of the Study

The study should be considered to stress the importance of the posture optimization as an easy and cost-effective supplemental treatment to conventional approaches to hypertension. This increases support for the need to account for biomechanical elements within the context of improving outcome of non-pharmacological therapies. They are useful to clinical practice and home-based cares, in order to enhance the sustainable processes of hypertension management.

Future Recommendations

Further research should undertake to increase the sample population's age range by recruiting prospective coffee consumers who are men, patients of a younger age, as well as those who suffer from mild or moderate hypertension. Future primary preventive IHG and DB research should employ follow-up designs to establish the durability of posture-based interventions. Future studies could extend the present analysis by studying other postures and their impact on other aspects of human health, including, at least, psychological health and metabolic health. It would also be constructive to conduct a combination of randomized controlled trials to enhance the efficacy of the above conclusions.

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