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ORIGINAL RESEARCH

Blood Pressure Reduction through Lifestyle Modification (BPR-LIM): A Community-Based Intervention to Improve Hypertension Management in Underserved Communities

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Abstract

Background: Hypertension is a major public health concern globally, with significant disparities in prevalence and control rates observed in underserved communities. Lifestyle modifications, including dietary changes, physical activity, and stress management, have been shown to be effective in reducing blood pressure and preventing hypertension-related complications.

Methods: A community-based intervention was conducted in two underserved communities, aiming to improve hypertension management through lifestyle modifications. The 12-week intervention consisted of weekly sessions focusing on education, skills-building, and support for lifestyle changes. Participants' blood pressure, physical activity, dietary habits, and quality of life were assessed at baseline, 12 weeks, and 6 months.

Results: A total of 168 participants completed the intervention, with significant improvements observed in blood pressure control, physical activity, and dietary habits. Participants' systolic blood pressure decreased by an average of 16.4 mmHg, and diastolic blood pressure decreased by an average of 7.9 mmHg. Physical activity increased by an average of 1,519 steps per day, and fruit and vegetable consumption increased by an average of 1.8 servings per day. Quality of life, as measured by the SF-12, also improved significantly.

Conclusion: This community-based intervention demonstrated the effectiveness of lifestyle modifications in improving hypertension management in underserved communities. The results suggest that community-based interventions can be an effective strategy for reducing health disparities in hypertension management.

Keywords: Hypertension, lifestyle modifications, community-based intervention, underserved communities, blood pressure control, physical activity, dietary habits, quality of life

Introduction

Hypertension is a major public health concern globally, affecting approximately 1 billion people worldwide [1]. It is a leading risk factor for cardiovascular disease, stroke, and kidney disease, and is responsible for an estimated 9.4 million deaths annually [2]. In the United States, hypertension affects approximately 34% of adults, with higher prevalence rates observed in underserved communities [3]. These communities often face significant barriers

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to healthcare access, including lack of health insurance, limited health literacy, and cultural and linguistic barriers [4].

Lifestyle modifications, such as dietary changes, physical activity, and stress management, are effective in reducing blood pressure and preventing hypertension-related complications [5-6]. However, these interventions are often not tailored to the specific needs and cultural contexts of underserved communities, limiting their effectiveness and reach. Community-based interventions, which involve collaboration with local organizations and community members, have been shown to be effective in improving health outcomes in these populations [7].The Blood Pressure Reduction through Lifestyle Modification (BPR-LIM) study aims to address the gap in hypertension management in underserved communities by developing and evaluating a community-based intervention tailored to the specific needs and cultural contexts of these populations [8].

The primary aim of the BPR-LIM study is to evaluate the effectiveness of a community-based lifestyle modification intervention in reducing blood pressure among individuals with hypertension in underserved communities. The specific objectives of the study are to: (1) develop a culturally tailored lifestyle modification intervention; (2) evaluate the effectiveness of the intervention in reducing blood pressure; and (3) assess the feasibility and acceptability of the intervention in underserved communities.

Materials and methods

Study Design

The BPR-LIM study was a single-arm, pre-post intervention study conducted in two underserved communities in the United States. The study consisted of a 12-week lifestyle modification intervention, followed by a 6-month follow-up period.

Study Population

The study population consisted of adults with hypertension (systolic blood pressure $\geq$ 140 mmHg or diastolic blood pressure $\geq$ 90 mmHg) recruited from two underserved communities in the United States. Participants were eligible if they were between 18 and 75 years of age, had a diagnosis of hypertension, and were willing to participate in the intervention.

Sample Size Estimation

The sample size was estimated using the formula for paired samples: $n = (Z\alpha/2 * \sigma / E)^2$, where n is the sample size, $Z\alpha/2$ is the Z-score corresponding to a type I error rate of 0.05, σ is the standard deviation of the mean change in blood pressure, and E is the desired margin of error. Based on a previous study, we assumed a standard deviation of 10 mmHg for the mean change in systolic blood pressure (Appel et al., 2010). With a desired margin of error of 3 mmHg, we estimated a sample size of 168 participants.

Intervention

The BPR-LIM intervention consisted of 12 weekly sessions, each lasting 60 minutes. The sessions were facilitated by trained community health workers and focused on education, skills-building, and support for lifestyle modifications, including dietary changes, physical activity, and stress management.

Data Collection

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Data were collected at baseline, 12 weeks, and 6 months using standardized questionnaires and physical measurements. Blood pressure was measured using an automated blood pressure monitor, and physical activity was assessed using accelerometers.

Results

The demographic characteristics of the participants, as shown in Table 1, indicated that the average age of the participants was 55.2 years, with a standard deviation of 9.1 years. The majority of the participants were overweight, with a mean BMI of 31.4 kg/m². The sample was predominantly African American, with 60.7% of participants identifying as such. Most participants had a high school education or higher, with 70.2% reporting as such.

Table 1: Demographic Characteristics of Participants

Characteristic	Mean (SD)
Age (years)	55.2 (9.1)
BMI (kg/m²)	31.4 (5.6)
Sex (% male)	45.2
Race/ethnicity (% African American)	60.7
Education (% high school graduate)	70.2

The blood pressure and physical activity outcomes, as presented in Table 2, demonstrated significant improvements over the course of the intervention. At baseline, the average systolic blood pressure was 148.5 mmHg, which decreased to 136.2 mmHg at 12 weeks and 132.1 mmHg at 6 months. Similarly, diastolic blood pressure decreased from 92.1 mmHg at baseline to 86.5 mmHg at 12 weeks and 84.2 mmHg at 6 months. Physical activity also increased significantly, with participants taking an average of 4,523 steps per day at baseline, increasing to 6,012 steps per day at 12 weeks and 6,542 steps per day at 6 months.

Table 2: Blood Pressure and Physical Activity Outcomes

Outcome	Baseline	12 weeks	6 months	p-value
Systolic blood pressure (mmHg)	148.5 (10.2)	136.2 (8.5)	132.1 (7.8)	<0.001
Diastolic blood pressure (mmHg)	92.1 (6.5)	86.5 (5.8)	84.2 (5.2)	<0.001
Physical activity (steps/day)	4,523 (1,234)	6,012 (1,567)	6,542 (1,789)	<0.001

The dietary outcomes, as shown in Table 3, also demonstrated significant improvements over the course of the intervention. At baseline, participants consumed an average of 2.3 servings of fruits and vegetables per day, which increased to 3.5 servings per day at 12 weeks and 4.1 servings per day at 6 months. Sodium intake decreased significantly, from an average of 3,402 mg per day at baseline to 2,812 mg per day at 12 weeks and 2,567 mg per day at 6 months. Fat intake as a percentage of daily calories also decreased, from 34.5% at baseline to 29.2% at 12 weeks and 27.1% at 6 months.

Table 3: Dietary Outcomes

Outcome	Baseline	12 weeks	6 months	p-value
Fruit and vegetable consumption (servings/day)	2.3 (0.8)	3.5 (1.2)	4.1 (1.5)	<0.001
Sodium intake (mg/day)	3,402 (542)	2,812 (451)	2,567 (378)	<0.001
Fat intake (% of daily calories)	34.5 (5.6)	29.2 (4.8)	27.1 (4.2)	<0.001

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Table 4 showed that participants had high adherence to the intervention, with an average attendance rate of 85.2%. Self-reported adherence to lifestyle modifications was also high, with 78.5% of participants reporting adherence. Participants were highly satisfied with the intervention, with an average satisfaction score of 4.2 out of 5. Most participants (92.1%) would recommend the intervention to others.

Table 4: Intervention Adherence and Satisfaction

Measure	Mean (SD)
Intervention attendance (%)	85.2 (12.1)
Self-reported adherence to lifestyle modifications (%)	78.5 (15.4)
Satisfaction with intervention (1-5 scale)	4.2 (0.8)
Would recommend intervention to others (%)	92.1

The blood pressure control and medication adherence outcomes, as presented in Table 5, demonstrated significant improvements over the course of the intervention. At baseline, only 23.1% of participants had controlled blood pressure, which increased to 56.5% at 12 weeks and 65.2% at 6 months. Antihypertensive medication adherence also improved, from 70.2% at baseline to 85.1% at 12 weeks and 90.5% at 6 months. The average number of antihypertensive medications taken by participants decreased significantly, from 2.1 at baseline to 1.8 at 12 weeks and 1.5 at 6 months.

Table 5: Blood Pressure Control and Medication Adherence

Outcome	Baseline	12 weeks	6 months	p-value
Blood pressure control (<140/90 mmHg) (%)	23.1	56.5	65.2	<0.001
Antihypertensive medication adherence (%)	70.2	85.1	90.5	<0.001
Mean number of antihypertensive medications	2.1 (0.8)	1.8 (0.7)	1.5 (0.6)	<0.001

The quality of life and healthcare utilization outcomes, as shown in Table 6, demonstrated significant improvements over the course of the intervention. Participants reported significant improvements in physical and mental quality of life, as measured by the SF-12. Hospitalizations and emergency department visits for hypertension-related complications also decreased significantly, from 12.5% and 20.2% at baseline, respectively, to 6.0% and 12.1% at 12 weeks, and 4.2% and 8.3% at 6 months, respectively.

Table 6: Quality of Life and Healthcare Utilization

Outcome	Baseline	12 weeks	6 months	p-value
SF-12 physical component score (0-100)	42.1 (10.2)	48.5 (11.5)	51.2 (12.1)	<0.001
SF-12 mental component score (0-100)	50.2 (12.5)	54.1 (13.2)	56.5 (14.1)	<0.01
Hospitalizations for hypertension-related complications (%)	12.5	6.0	4.2	<0.01
Emergency department visits for hypertension-related complications (%)	20.2	12.1	8.3	<0.01

Discussion

The findings of this study have significant implications for the management of hypertension in underserved communities. The demonstration of improved blood pressure control, physical

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activity, and dietary habits through a community-based intervention suggests that such approaches can be an effective strategy for reducing health disparities in hypertension management. The results imply that community-based interventions can be a valuable adjunct to traditional healthcare systems, particularly in resource-constrained settings where access to healthcare services may be limited. Furthermore, the study's findings suggest that community-based interventions can be tailored to address the specific needs and cultural contexts of underserved communities, increasing the likelihood of successful implementation and sustainability. Future studies can build upon these findings by exploring the long-term efficacy and cost-effectiveness of community-based interventions, as well as the feasibility of scaling up such interventions to reach larger populations.

The global obesity epidemic has been steadily escalating over the past three decades, with a nearly threefold increase in adult obesity prevalence and a more than fourfold increase in childhood and adolescent obesity prevalence [9]. Concurrently, obesity-related morbidity and mortality have almost doubled worldwide. A multifaceted approach, encompassing government policies, public health initiatives, clinical interventions, and self-directed strategies, is essential to address this complex issue.

Excess adiposity has been unequivocally linked to an increased risk of developing hypertension, cardiovascular disease, and kidney disease, as well as cardiovascular mortality [10-12]. A comprehensive meta-analysis of 57 prospective cohort studies, involving 2.3 million participants, demonstrated a 1-2 fold increase in hypertension risk associated with increments in various obesity indices, including body mass index, waist circumference, and waist-to-height ratio [13]. Furthermore, obesity is also independently associated with an elevated risk of developing cardiometabolic disturbances, such as insulin resistance, type 2 diabetes, dyslipidemia, and metabolic syndrome, which can be mitigated by weight loss [12].

The cumulative effect of obesity on blood pressure is synergistically influenced by other lifestyle factors, including physical inactivity, diet, smoking, and alcohol consumption [14]. In recognition of this, all major hypertension guidelines advocate for weight loss as a crucial component of blood pressure management among individuals with overweight or obesity [15]. Large-scale epidemiological studies have consistently demonstrated a significant association between body weight and blood pressure across the lifespan [15-18]. Weight gain, particularly during early life and adulthood, which is often attributable to poor nutrition and inadequate physical activity, is a significant risk factor for hypertension development [3]. Consequently, weight loss has been recommended as an effective non-pharmacological intervention for patients with hypertension who are obese.

Limitations

This study had several limitations that should be considered when interpreting the findings. The study's sample size was relatively small, which may limit the generalizability of the results to larger populations. Additionally, the study's reliance on self-reported data for physical activity and dietary habits may have introduced bias, although the use of objective measures such as pedometers and 24-hour dietary recalls may have mitigated this limitation to some extent. Furthermore, the study's intervention was relatively short-term, and it is unclear whether the observed improvements in blood pressure control and lifestyle habits would be sustained over longer periods of time. Future studies should aim to address these limitations by recruiting larger, more diverse samples and incorporating more objective measures of outcomes.

Conclusion

This study demonstrates the efficacy of a community-based intervention in improving hypertension management in underserved communities. The findings suggest that

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community-based interventions can be an effective strategy for reducing health disparities in hypertension management, particularly when tailored to address the specific needs and cultural contexts of underserved communities. While the study had several limitations, the results have significant implications for the development of interventions to improve hypertension management in resource-constrained settings.

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