Investigating the Effectiveness of Nursing Follow-Up Programmes in Preventing Cardiovascular Complications Among Hypertensive Patients in Community Healthcare Centres

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ABSTRACT

The medical issue in this case is the hypertensive condition that affects about 1.4 billion people worldwide, where only 23% of the patients have their blood pressures controlled. This study aimed to establish the effectiveness of nurse follow-up programs in community-based health centers in preventing cardiovascular disease among hypertensive patients. The study design proposed for use involves cluster randomization whereby 12 health centers will be selected equally to either the nurse follow-up program or the control group. The sample population comprised adult patients aged 30 years or older with a blood pressure of 140/90 mm Hg or above. The simulation was conducted by means of the Welch t-test, Mann-Whitney test and Poisson regression. In the nurses' follow-up group, there was a reduction in systolic pressure by 14.1 mm Hg, while the reduction in usual care was 5.5 mm Hg. Controlled blood pressure was 60.8% vs 39.5%, while medication adherence was 76.7% vs 56.7% (all $p < 0.001$). The incidence rates for the two groups were 5.41 vs 10.41 per 100, giving the rate ratio as 0.52 (95% CI 0.43 to 0.63). The NNT is equal to 20, meaning that structured follow-up can prevent one event out of 20 people. These numbers are hypothetical because the simulation is done, but in reality, results would be lower.

Keywords:-Blood pressure, Nurse, Centres, Systolic, Follow-up, Cardiovascular, Patients, Events, Control, Adherence

1.INTRODUCTION

Hypertension is still one of the most dangerous health challenges for the global population. According to the World Health Organization (WHO), 1.4 billion adults aged 30 to 79 years have hypertension. Only 23% of such patients manage to keep their blood pressure under control, and there are 99 countries where this rate is lower than 20% (WHO, 2025). This disease causes strokes, myocardial infarctions, and kidney failures, leading to more than 10 million deaths annually (WHO, 2025). Primary care plays a key role in the treatment and prevention of hypertension when nurses perform follow-ups on their patients (Ito et al., 2024). The roles of nurses are associated with monitoring patients' condition, as well as education about taking prescribed medicines and living a healthy lifestyle (Ito et al., 2024). According to 37 randomized trials, nurse-led interventions helped reduce systolic blood pressure by 4.66 mm Hg (Bulto et al., 2024). There were 9,731 patients who experienced some improvement in nutrition and exercise practices (Bulto et al., 2024). As a result, 35 studies revealed that the risk ratio regarding the management of

blood pressure increased to 1.10 (Ito et al., 2024).Nurse prescribing reduced systolic blood pressure by 16.54 mm Hg in randomized controlled trials (Vay-Demouy et al., 2025). Studies differ greatly in their methodology, making comparisons difficult among healthcare settings (Vay-Demouy et al., 2025). Yakob et al. (2026) reviewed 11 studies carried out in low- and middle-income countries, proving the improvement in blood pressure regulation. Nevertheless, patient retention rates differed a lot between studies, which can negatively impact the follow-up process (Yakob et al., 2026). In Bangladesh, control of blood pressure increased from 15% to 56% due to better screening and follow-up procedures (WHO, 2025). Evidence for cardiovascular complications is not well-developed due to the lack of studies that consider clinical complications, while reviews focus mostly on blood pressure levels (Vay-Demouy et al., 2025). Such evidence is necessary since the vast majority of those affected reside in low- and middle-income countries (WHO, 2025). The present study explores the impact of nurse follow-up programs in community healthcare centers on cardiovascular complications among patients with hypertension

2. RELATED WORK

Community follow-up of patients by nurses in their health care practice is not a secondary intervention but the primary step towards fighting cardiovascular diseases. According to Hannan et al. (2022), nurses perform leadership and caring roles in managing hypertension. The reason for their involvement is due to the absence of advancement in controlling hypertension in the US within over a decade (Hannan et al., 2022). Blood pressure measurement is an important nursing intervention in the diagnosis and management of patients (Hannan et al., 2022). This is because task sharing is essential, as there is a scarcity of trained personnel to diagnose, monitor, or treat hypertension in many areas (Gamage et al., 2020). In rural India, health workers raised blood pressure control from 49.5% to 69.7% (Gamage et al., 2020). Regular care increased blood pressure control from 52.2% to 61.7%; therefore, structured follow-up became useful (Gamage et al., 2020).

However, according to the DISHA study, minimally trained workers were unable to lower the mean blood pressure in villages in India (Kondal et al., 2022). It appears that the efficiency of follow-up programs is related to the degree of training and protocols used. In China's rural areas, the provision of community health workers without the degree of physicians made it possible to reduce the number of patients with cardiovascular diseases aged 65 or more by 25% (Guo et al., 2024). Also, the death rate decreased by 10%, which means that follow-up programs may have an impact on the prevention of such serious diseases (Guo et al., 2024). The improvement in the quality of life and functional abilities was achieved through nurse-led cardiac rehabilitation of people with cardiovascular diseases (Miah et al., 2025). The low to moderate quality of evidence in the use of nurses' practices in treating cardiovascular diseases has been shown by Smigorowsky et al. (2020). There were no significant differences in results; nevertheless, the Framingham risk score was reduced by 12% (Smigorowsky et al., 2020). However, there are no data connecting the complications of hypertensive diseases and nursing follow-up programs in community healthcare centers. Thus, policymakers should finance nursing follow-up programs, while researchers need to share clinical event information.

3. METHODOLOGY

The cluster randomized controlled trial design is encouraged, following previous similar trials on hypertensive patients in communities (Gamage et al., 2020). There was an allocation of 12 community clinics in a 1:1 ratio for nurse follow-up and routine care. Patients aged 30 and above with a diagnosis of 140/90 mm Hg of blood pressure was used. Interventions involved nurses' visits on a monthly basis, at-home blood pressure checks, and education regarding medication usage and lifestyles over one year. A stepped approach by the nurses was adopted, taking into account the community approach for lowering the incidence (Guo et al., 2024). The occurrence of strokes, myocardial infarctions, and kidney disorders, based on the clinical data, was form the primary outcomes. Other outcomes included blood pressure levels, compliance, and retention measured every three months using validated tools.

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Figure 1: Diagnosis of the selected patient

Dataset

Simulated Cluster-Level Dataset (12 Community Healthcare Centres, 12 Month Follow-Up)

entre	**rm**	**Enrolled (n)**	**Baseline SBP (mmHg)**	**2 Month SBP (mmHg)**	**SBP Reduction (mmHg)**	**BP Control (%)**	**Medication Adherence (%)**	**V Events (n)**	**vents per 100**
1		100	156.2	41.8	14.4	62	78		.0
3		95	154.8	42.5	12.3	58	74		.3
4		110	157.5	40.9	16.6	65	81		.5
7		105	155.1	43.0	12.1	57	72		.7
9		98	156.9	41.2	15.7	63	79		.1
12		102	155.6	42.1	13.5	60	76		.9
urse arm total or mean		**610**	156.0	41.9	**14.1**	**60.8**	**76.7**	**3**	**.4**
2		104	155.9	50.2	5.7	41	58	0	.6
5		96	156.4	51.0	5.4	38	55	1	1.5
6		108	154.7	48.9	5.8	43	60		.3
8		99	157.1	52.3	4.8	36	54	2	2.1
10		101	155.3	49.6	5.7	40	57	0	.9
11		97	156.0	50.4	5.6	39	56	1	1.3

sual care total or mea n		**6 05**	1 55.9	50.4	**5. 5**	3 **9.5**	**56.7**	**3**	**0.4**

4. RESULTS

Profile of Participating Centres

Table 1. Mean (SD) Cluster-Level Outcomes at Baseline and 12 Months by Study Arm

Outcome	Nurse follow-up (6 centres)	Usual care (6 centres)
Patients enrolled per centre	101.7 (5.3)	100.8 (4.5)
Baseline SBP (mm Hg)	156.02 (1.05)	155.90 (0.84)
12-month SBP (mm Hg)	141.92 (0.79)	150.40 (1.17)
SBP reduction (mm Hg)	14.10 (1.82)	5.50 (0.37)
BP control (%)	60.83 (3.06)	39.50 (2.43)
Medication adherence (%)	76.67 (3.33)	56.67 (2.16)
CV events per centre (n)	5.50 (1.05)	10.50 (1.05)
CV events per 100 patients	5.42 (1.03)	10.46 (1.42)

Baseline systolic pressure was the same in both groups (156.0 mm Hg in nurse centres and 155.9 mm Hg in usual care centres). However, 12 months later, systolic pressure was 141.9 mm Hg in nurse centres and 150.4 mm Hg in usual care centres. The mean systolic blood pressure change was 14.1 mm Hg in nurse centres and 5.5 mm Hg in usual care. Control of blood pressure in nurse centres was 60.8% compared to only 39.5% in usual care centres. Mean adherence to medications was 76.7% in nurse centres and 56.7% in usual care centres; the difference was 20.0%. The mean number of cardiovascular events per centre was 5.5 in nurse centres and 10.5 in usual care centres. The standard deviation was very small (less than 3.4) for all clinical outcomes. Such a high homogeneity of centres is typical of simulated data because there is no variation in centre features that could increase heterogeneity between them.

Contrast Between Intervention and Control Centres

Table 2. Welch t Test and Mann-Whitney U Test Comparing Nurse Follow-Up With Usual Care (n = 12 Centres)

Outcome	Mean difference (Nurse minus Usual)	9 5% CI	elch t	f	val ue	C ohen's d	Ma nn-Whitney p
Baseline SBP (mm Hg)	0.12	− 1.11 to 1.35	.21	.5 3	.836	0 .12	0.93 7
12-month SBP (mm Hg)	−8.48	− 9.80 to −7.17	14.69	.7 4	0.00 1	− 8.48	0.00 2
SBP reduction (mm Hg)	8.60	6 .70 to 10.50	1.36	.4 1	0.00 1	6 .56	0.00 5

BP control (%)	21.33	17.75 to 24.91	3.37	.51	0.001	.72	0.002
Medication adherence (%)	20.00	16.31 to 23.69	2.35	.58	0.001	.13	0.002
CV events per 100	−5.05	−6.66 to −3.43	7.05	.12	0.001	−4.07	0.002

The baseline systolic pressure in arms was not significantly different (difference 0.12 mm Hg, p=0.836), thereby confirming the success of randomization. Systolic pressure was on average 8.48 mm Hg lower in nurse centres (95% CI 7.17 to 9.80, p<0.001). The reduction in systolic pressure was 8.60 mm Hg higher when follow-up by nurses took place (95% CI 6.70 to 10.50, p<0.001). Control rates were 21.33 percentage points higher (95% CI 17.75 to 24.91, p<0.001). Adherence rate was 20.00 percentage points higher, and event rates were 5.05 per 100 lower (p<0.001 for both). Values of Welch t statistics ranged from 7.05 to 14.69 in absolute terms, while the number of degrees of freedom varied from approximately 5 to 10. Similar results were obtained using the Mann-Whitney test, with the exact p-values ranging from 0.002 to 0.005 for all post-baseline outcomes. Values of Cohen's d were above 4.0 for all post-baseline outcomes, which is very high for field trials.

Pressure Change Inside Each Arm

Table 3. Paired t Test of Systolic Blood Pressure Change From Baseline to 12 Months Within Each Arm

Arm	Baseline SBP (mm Hg)	12-month SBP (mm Hg)	Mean change (SD)	Paired t	f	value
Nurse follow-up	156.02	141.92	14.10 (1.82)	19.01		0.001
Usual care	155.90	150.40	5.50 (0.37)	36.53		0.001

The reduction in systolic blood pressure was significantly observed in both arms from baseline to 12 months (paired t-tests, df 5). In nurse centres, the reduction was in 14.1 mm Hg, hence producing a t-statistic of 19.01 and p < 0.001 for 6 centres. In usual care centres, the reduction was 5.5 mm Hg, hence producing a t-statistic of 36.53 and p < 0.001 for 6 centres. The high t-statistics in the usual care group are attributed to its low variance and not because of a large effect size. There was a significant reduction in the usual care group, which can be caused by regression towards the mean, secular changes, or an effect of meeting the doctor in the clinics. Therefore, it indicates that the effect of the intervention can be observed in the differences between the two arms, which is 8.60 mm Hg. There was a systolic reduction in nurse follow-up that was 2.6 times higher than usual care. It is higher than the pooled effect of 4.66 mm Hg in 37 studies (Bulto et al., 2024).

Clinical Event Burden and Risk Estimates

Table 4. Cardiovascular Event Rates, Rate Ratio, Odds Ratio and Absolute Risk Reduction by Study Arm

Measure	Nurse follow-up	Usual care	Effect estimate	95% CI	p value
Events/patients	33 / 610	63 / 605	not applicable	not applicable	not applicable
Events per 100 patients	5.41	10.41	not applicable	not applicable	not applicable
Rate ratio (centre-level Poisson, scale-adjusted)	not applicable	not applicable	0.52	0.43 to 0.63	< 0.001

Rate ratio (robust Poisson)	not applicable	not applicable	0.52	0.44 to 0.62	< 0.001
Odds ratio (unadjusted)	not applicable	not applicable	0.49	0.32 to 0.76	0.001
Chi-square (unadjusted, df 1)	not applicable	not applicable	10.45	not applicable	0.001
Absolute risk reduction (percentage points)	not applicable	not applicable	5.00	not applicable	not applicable
Number needed to treat	not applicable	not applicable	20	not applicable	not applicable

Nurse follow-up centers observed 33 cases among 610 patients, thus giving 5.41 events per 100 patients. In contrast, the usual care centers had 63 cases among 605 patients, equaling 10.41 events per 100 patients. The rate ratio from the center-level Poisson regression analysis is 0.52 (95% CI 0.43 to 0.63, p<0.001), which implies a 48% relative decrease in the number of cardiovascular events by using structured nursing follow-up for 12 months. With a rate difference of 5.00 percentage points, the number needed to treat would be 20 to prevent one case. The unadjusted odds ratio is 0.49 (95% CI 0.32 to 0.76), and chi-square is 10.45 (p=0.001). However, the pooled patient-level test does not account for clustering of the data, so the center-level estimate remains the primary and safer one. Similarly to the direction of effect, there is a 25% cardiovascular risk reduction among the older adult population in rural China (Guo et al., 2024). The 48% reduction is simulated and purely illustrative.

Pathway Links and Test Assumptions

Table 5. Pearson Correlations and Shapiro-Wilk Normality Tests Across 12 Centres

Test	**Variables or group**	**Statistic**	**p value**
Pearson r	Medication adherence and SBP reduction	0.993	< 0.001
Pearson r	BP control and SBP reduction	0.991	< 0.001
Pearson r	BP control and events per 100	−0.974	< 0.001
Shapiro-Wilk W	SBP reduction, nurse follow-up	0.935	0.617
Shapiro Wilk W	SBP reduction, usual care	0.797	0.055

There was almost perfect correlation between adherence and systolic reduction in 12 centers ($r = 0.993$, $p < 0.001$). Control and systolic reduction were also highly correlated ($r = 0.991$, $p < 0.001$). The rates of control were also highly negatively correlated with the rates of events (correlation magnitude of $r = 0.974$, $p < 0.001$). This pattern of correlation is consistent with the hypothesized pathway from nurse follow-up to adherence and control, resulting in lower rates of events. However, with only 12 centers and 2 arms, correlations are due to differences between arms and not the presence of mediation. Testing by the Shapiro-Wilk method indicated that reductions in systolic blood pressure for the nurse follow-up group were normally distributed in 6 clusters ($p = 0.617$). Systolic reductions in the condition of usual care were not normally distributed ($p = 0.055$); therefore, Mann-Whitney test results can be used as an additional consistency check on the direction of each simulated result. Results of parametric and non-parametric tests are consistent; this gives us more certainty about the direction of each result. A trial with 12 centers should include adjustment for clustering.

5. DISCUSSION

From the simulated findings, nurse follow-up was associated with the decrease in the systolic blood pressure by 14.1mm Hg and decreased events by 48%. The levels of control of hypertension are lower in South Asia and sub-Saharan Africa (NCD Risk Factor Collaboration, 2021). This means that nurse programs would help to reduce such inequalities in resource-limited community healthcare centers in India. The

village doctors helped in achieving 57.0% of their patients below 130/80 mm Hg while only 19.9% were able to achieve this in the controls (Sun et al., 2022). In Sun et al. (2022), the coaching on home monitoring and lifestyle was comparable to the nurses' follow up carried out in this study. The simulated adherence increase of 20.00 points is comparable with this mechanism though there is no necessary causality. The difference of 37.0 points in the control patients in Sun et al. (2022) was higher compared to the simulated difference of 21.33 points. The systolic difference of 14.5mm Hg was also higher compared to the simulated difference of 8.60 mm Hg.

An 8.60 mm Hg difference represents a roughly 15% to 17% decrease in cases, which is far lower compared to the assumed 48% rate of decrease in the simulation study. The CRHCP found a hazard ratio of 0.67, which is a much more reasonable ratio compared to the assumed 48% in the case (He et al., 2023). Additionally, a higher incidence of hypotension was seen in the intervention condition (1.75% against 0.89%), and, hence, caution must be exercised when dealing with patient safety (He et al., 2023). Based on the findings of Li et al. (2024), it appears that simulating the scenario of 20 years showed that the CRHCP programme

would be cost-saving for health care systems. Overall, it appears that nursing follow-up can be an interesting and low-cost strategy to avoid the complications of hypertension. As our dataset was simulated with 12 centres, it cannot be used for any real-life clinical decisions.

6. CONCLUSION

The follow-up by nurses in community health care centers appears to be very promising in terms of the prevention of complications due to the presence of high blood pressure in cardiovascular diseases. The nurse clinics in the simulations have been able to lower the systolic blood pressure levels by 14.1 mm Hg, control blood pressure levels by 60.8%, and reduce the chances of any cardiovascular complications by 48%. The nurses will be able to provide the necessary monitoring, counseling, and education to ensure compliance and detection of any problems. The risk estimates are higher compared to the actual number of trials and hence the actual benefits will be lower and will have to be confirmed. The policy makers should promote nurse follow-up programs with proper guidelines and supervision.

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